VOL. XVIII • NO. 1 • JANUARY 1980

DEVELOPMENT DIGEST

The DEVELOPMENT DIGEST is prepared for the Agency for International Development by the National Planning Association, a private, non-profit organization in Washington, D.C.

We would appreciate comments of an editorial nature and suggestions of material for possible inclusion in the DIGEST. Please address:

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 2, 1966.

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DEVELOPMENT DIGEST

A quarterly journal of excerpts, summaries, and reprints
of current materials on economic and social development

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Prepared by the National Planning Association

for

Agency for International Development, U.S. Department of State

TO READERS OF THE DEVELOPMENT DIGEST

The January 1979 issue of the Development Digest had a questionnaire for readers which a number of you completed and sent to the Agency for International Development in Washington. Later in the year, a second and more elaborate questionnaire was mailed to a number of people who had answered the first one, as well as to readers selected from the overall mailing list. At present all these questionnaire results are being analyzed.

We in the Agency for International Development, and the editors of the Digest, would like to thank all of you who have given us your assistance by returning these questionnaires. In the next issue of the Development Digest we will give you a comprehensive report on these questionnaire results, which indicate Digest readers' views on subjects in the journal and other related matters.

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Industry in Developing Countries: Some Recent Trends

UNIDO

[This extract from a UNIDO survey of world industry since 1960 deals with employment, labor productivity, technology, and rural industry, and some of the differences between developing and developed economies.]

Comparative Growth Trends in Manufacturing

Analysis of the growth trends in employment, output (value added), and labor productivity in manufacturing over the 16 years from 1960 through 1975 (Table 1) reveals great divergencies among the three country groupings. It is evident that the developing countries registered a strong, though uneven, growth in manufacturing employment in this period at faster rates than in the developed-market or centrally-planned economies. The annual growth rate for developing countries was 4.9 percent in 1960-1975; in the shorter period 1968-1975, growth accelerated to achieve an average of 7.0 percent per annum.

These growth rates for the developing countries are not only high in comparison with those attained by the other two main groupings, but high measured against historical levels. High rates of growth in employment were associated with still higher growth in output, so that labor productivity in the manufacturing sector of the developing countries has risen over the period. However, it is evident from the data in Table 1 that the gap between productivity in these countries and that in the other groupings widened, since the productivity gains in the more developed countries were clearly greater.

Report of the United Nations Industrial Development Organization (UNIDO) with headquarters in Vienna, Austria

TABLE 1

Annual Growth Rates of Manufacturing Employment, Value Added, and Labor Productivity, 1960-1976

	Employment		Value Added		Labor Productivity	
	1960-1975	1968-1975	1960-1975	1968-1975	1960-1975	1968-1975
Developing countries	4.9	7.0	7.4	9.1	2.4	2.0
Latin America	4.7	7.9	8.0	9.7	3.2	1.7
Asia	4.4	6.5	6.9	8.1	2.4	1.5
Developed market economies	0.9	0.4	5.7	4.1	4.8	3.7
Centrally planned economies	3.4	2.6	10.0	10.7	6.4	7.9
World average	2.8	2.9	7.1	6.5	4.2	3.5

Source: Statistical Yearbook 1977 (United Nations publication, Sales No. 78.XVII.1); Yearbook of Industrial Statistics, 1976 Edition, Vol. I (United Nations publication, Sales No. 78.XVII.3E); and data supplied by the United Nations Statistical Office.

The growth of manufacturing output and employment in the developed market economies exhibited cyclical fluctuations in the 1960s, followed by stagnation from the beginning of the 1970s and then a decline in 1974 and 1975. Typically for the initial period of a recession, the contraction in employment in 1974 and 1975 was somewhat smaller than the decrease in output. The centrally planned economies maintained a relatively steady growth of output and employment, although the rate of employment growth has been declining since 1968. The labor force in these countries was growing at a slow rate; while labor shortages were being felt in some sectors of the centrally planned economies, agriculture still absorbed more than one third of the total labor force of these countries.

Some recent data on trends in employment expansion from the early 1970s are available for 35 developing countries, and are presented in Table 2 with corresponding data on the growth of the total and the non-agricultural labor force in 1970-76. Growth rates in the supply of labor ranged from 1.1 percent per annum in Jamaica to 3.7 percent in Venezuela; in most countries it was increasing at a rate above 2.5 percent. Only four countries, at different levels of per capita income, experienced a contraction of employment in manufacturing during the period: Chile, Guatemala, Sri Lanka and Uganda.

TABLE 2

Annual Growth Rates of the Labor Force in the Whole Economy, Non-Agricultural Sectors, and Manufacturing, 35 Developing Countries, 1970 to 1976
(Percentages)

Country or area, by income group[a]	*Total labour force*[b]	*Employment in non-agricultural sectors*	*Employment in manufacturing*
Low (<$265)			
Ethiopia	1.95	...	4.0[b]
India	1.96	2.6	2.1
Kenya	2.60	6.6	6.5
Malawi	1.91	7.0	9.3
Pakistan	2.50	5.0	...
Sierra Leone	1.81	-1.6	1.3[b]
Sri Lanka	2.51	3.6[c]	-1.4[c]
Lower middle ($265-$520)			
Egypt	2.45	4.5[d]	3.9[d]
El Salvador	3.28	3.7[d]	5.0[d]
Jordan	2.88	9.6	6.9
Nigeria	2.06	...	8.1[d]
Philippines	2.68	1.5[c]	3.8
Thailand	2.87	2.5[e]	...
Uganda	2.40	2.5[f]	-0.5[f]
United Republic of Cameroon	1.37	2.2	20.0
Zambia	2.44	2.4[d]	1.6[d]
Intermediate middle ($521-$1,075)			
Algeria	2.84	...	11.5[b]
Chile	2.48	...	-0.7
Colombia	3.19	...	3.4
Cuba	1.78	3.7[g]	2.7[h]
Dominican Republic	3.08	...	6.7[d]
Ecuador	3.24	...	3.3[d]
Guatemala	2.93	...	-3.6[c]
Mauritius	3.26	11.1	23.7
Republic of Korea	2.93	6.1	16.8
Swaziland	2.18	9.4[b]	13.3[b]
Syrian Arab Republic	2.64	6.6[d]	3.4[h]
Tunisia	2.30	6.6[d]	...
Upper middle ($1,076-$2,000)			
Hong Kong	2.92	...	1.7
Jamaica	1.10	2.5[i]	3.8[d]
Panama	2.74	2.7	4.1[b]
Trinidad and Tobago	2.41	3.6[j]	...
High (>$2,000)			
Brunei	...	...	7.7[e]
Puerto Rico	2.11	1.1	0.6
Venezuela	3.70	...	5.0

Source: Based on ILO, *Yearbook of Labour Statistics 1977*, and ILO, *Labour Force Estimates 1950-1970 and Projections 1975-2000*, 2nd ed. (Geneva 1977).

Note: Rates of growth for the non-agricultural and manufacturing sectors are calculated using regression on time.

[a] According to GNP *per capita* at 1975 dollars. [b] 1970-1975. [c] 1971-1975. [d] 1970-1974. [e] 1972-1976. [f] 1970-1973. [g] 1971-1974. [h] 1972-1975. [i] 1969-1976. [j] 1970-1976.

The data in Table 2 show that the growth rates of manufacturing employment in most developing countries in the period 1970-1976 were much higher than the rates of growth of the labor force, and even of the urban labor force. Many developing countries experienced a phenomenal percentage growth in manufacturing employment, which reflects the small size of the industrial sector in these countries at the beginning of the 1970s. There was a noticeable tendency for employment in manufacturing to grow more rapidly than that for the non-agricultural sectors. The level of per capita income, which is normally taken as a proxy for the level of economic development, had little relationship with the performance of the manufacturing sector in generating employment.

Employment and Productivity

In the manufacturing sector of industrialized countries the regular interaction of output and productivity has been noted and studied. It was found that in a number of these countries productivity increased most rapidly when output was also increasing rapidly --according to the so-called "Verdoorn Law." Fresh evidence in support of this Law is found in a recent ECE study on the growth of industry in Europe. It is doubtful, however, that the same relationships would apply to developing countries. Technical progress, economies of scale, and growth in productivity owing to the process of "learning by doing" are no doubt at work in developing countries as well, but under different social, technical and economic conditions.

Firstly, substantial manufacturing activity in developing countries is carried out in the traditional sub-sector, with the help of part-time manual workers of low productivity. In time this subsector tends to shrink, but it is not negligible. Secondly, investment (embodied technical changes) seems to be more concentrated, and capacity utilization tends to be lower in developing countries than in industrialized countries. These factors are unlikely to contribute to a uniform, one-directional effect on output and employment in terms of the benefits of economies of scale, or to provide feedback in the form of the effects of rapidly growing productivity on the structure of demand and investment.

Data for developing countries are scant and not entirely comparable. A cross-country analysis of linear regression of employment growth and productivity growth on output growth, covering nine countries (Argentina, Brazil, Chile, Colombia, Ecuador, India, Mexico, the Republic of Korea and Venezuela) for the period 1968-1974, gives the following results:

$$E = 0.909 + 0.480X;\ R^2 = 0.76;\ t = 4.77$$
$$P = 0.661 + 0.466X;\ R^2 = 0.77;\ t = 4.86$$

where E = employment growth, P = productivity growth, and X = output growth. These results appear to be different from those of the ECE study on the industrialized countries of Europe. For developing countries, rates of employment growth are generally higher, and their contribution to the growth of output is greater than is the contribution of increases in labor productivity; the figures for productivity growth rates in Table 1 suggest a wide difference between the two rates. A plausible explanation for such a difference is that the developing countries with under-employed labor available can undergo a rapid growth in output without a noteworthy growth in productivity. In other words, capital investment "widening" receives greater emphasis than capital "deepening". Similar tendencies seem to have been at work in the late 1950s and early 1960s in the centrally planned economies, when industrialization proceeded under conditions of labor abundance. Now that full employment has been achieved, capital deepening is more pronounced, and the rates of employment growth are decreasing.

A survey of growth trends in employment, productivity and output for different branches of industry in 14 developing countries for which the data were available shows that the general trend towards a more rapid growth in employment than in productivity, observed for the manufacturing sector as a whole, is also discernible at the branch level. Gains in productivity exceed employment gains in less than one third of the countries in the sample, and in only a few branches of industry--textiles, clothing, footwear, wood products, non-metallic minerals products.

The long-term potential for industrial growth and increases in labor productivity and, consequently, for growth in income is linked with the composition of employment in industrial branches. In the early 1950s the criterion for assessing the potential of an industrial branch to induce growth in employment was primarily the capital-intensity of the branch. There is now a growing tendency to use a multi-factor criterion and a multi-stage procedure. The numbers employed per dollar invested are still important, but other considerations such as the potential contribution to technological advance, the development of skills, and the effect on the distribution of the gains of development are also taken into account. Different branches naturally have different potentials for inducing overall growth and technological development. For example, the manufacture of soft drinks (whatever the choice of production technique) and the manufacture of fertilizers or steel offer distinctly different possibilities as stimuli for further industrial growth and technological advance.

Table 3 gives the annual growth rates of employment for branches of industry over the period 1968-1975, together with the growth rates for light manufacturing and heavy manufacturing. Two general observa-

TABLE 3

Annual Growth Rates in Employment, by Branch of Industry, 1968-1975

Branch	ISIC	Developing countries	Latin America	Asia	Developed market economies	Centrally planned economies	World
Food, beverages and tobacco	31	4.8	5.7	3.9	-0.4	1.5	2.3
Textiles	321	5.1	3.6	4.7	-2.5	1.3	2.3
Wearing apparel, leather, footwear	322-324	8.7	9.4	8.5	-0.3	2.0	3.4
Wood and wood products, including furniture	33	8.1	...	8.2	0.3	1.0	3.4
Paper and paper products, printing and publishing	34	6.3	7.3	5.5	-	...	1.0
Chemicals	35	8.9	7.6	9.0	1.0	3.4	3.3
Non-metallic minerals	36	7.9	9.3	7.0	0.2	2.4	3.3
Basic metals	37	14.4	9.1	17.1	0.5	1.2	2.9
Metal products, machinery and equipment	38	9.5	11.1	8.7	1.0	3.5	2.8
Light manufacturing		6.2	7.0	5.7	-0.4	1.6	2.8
Heavy manufacturing		9.2	9.5	8.7	0.8	3.1	2.9
Total manufacturing		7.0	7.9	6.5	0.4	2.6	2.9

Source: Yearbook of Industrial Statistics, 1976 Edition, vol. I (United Nations publication, Sales No. 78.XVII.3E).

tions may be made. Firstly, at the industrial branch level, employment growth rates diverged widely in this period, ranging from 17.1 percent for basic metals in Asia and 11.1 percent for metal products in Latin America to - 2.5 percent for textiles and - 0.4 percent for food, beverages and tobacco in the developed market economies.

In developing countries, most manufacturing employment is in traditional industries such as food, textiles and wood products, all of which fall under light manufacturing. Over the period 1968-1975, food, textiles and wearing apparel together accounted for about 46 percent of the total increase in manufacturing employment. In the comparatively more industrially advanced region of Latin America, however, the three branches had a much smaller share in the regional growth of manufacturing employment; the highest growth in employment occurred in the metal products industry. The growth trends over the period 1968-1975 suggest that at higher levels of industrial development, the demand for labor shifts toward branches of heavy manufacturing.

Along with changes in the composition of employment, there has been a marked change in the structure of production. Heavy manufacturing improved its share in world manufacturing value added from 59.3 percent in 1960 to 67.7 percent in 1976. This occurred in the developed market economies, and the trend was even more pronounced in the centrally planned economies. Developing countries also participated in this trend; the share of heavy manufacturing in manu-

facturing value added for the developing countries rose from 37.5 percent in 1960 to 50.4 percent in 1975 (associated with only a moderate increase in this sector's share in manufacturing employment from 22.8 percent to 28.2 percent). Heavy manufacturing in the developing countries is highly concentrated; 5 countries accounted for more than half the total employment in this sector.

The more rapid expansion of employment in heavy manufacturing than in light manufacturing seems to have resulted not only from an increased production of capital goods or durable consumer goods, but also from the growing tendency of some developing countries to process their own natural resources, especially non-renewable ones. This is a comparatively new area of manufacturing in the Third World, and mainly concerns petrochemicals, iron and steel, and fertilizers. The production lines in this area tend to be capital-intensive. The establishment or expansion of these industries is largely motivated by better terms of trade for processed goods than for raw materials. From the viewpoint of employment generation, a development strategy might be based on the answers to such questions as: What kind of linkages would the local processing of natural resources generate? What kinds of employment, skills and technology would be available? Would the local processing of natural resources be a more viable industrial strategy for full employment than the local manufacture of capital goods?

Direct labor coefficients of most of the resource-based industries are low, often close to the lowest in the economy. Thus, resource-based industries do not seem to generate much direct employment. The few exceptions are leather goods and some products of wood, cork and rubber, which are considered highly labor-intensive. The literature on resource-processing industries does not provide much data on their potential to generate direct employment, but a few examples can be quoted. In Jamaica, the capital/labor ratio in bauxite and alumina production taken together was estimated at $34,000 per person in 1960, compared with a ratio of $7,000 per person in sugar milling and of $1,000 to $6,000 per person in most other manufacturing activities. In Colombia, an investment of $100 million in petrochemicals manufacture resulted in the employment of only 2,500 persons in 1967; the same investment in labor-intensive branches would have provided jobs for 50,000 persons, or one sixth of the manufacturing labor force in Colombia. Moreover, the resource-based industries are associated with a high proportion of raw material cost and a low share of labor cost, especially in developing countries. Technological changes are therefore geared to achieve efficiency in the use of raw materials, and seem to require fixed proportions of labor and capital.

The case for extending the local processing of natural resources rests not so much on its direct effect, however, as on its indirect effect on employment through linkages to other sectors. Available estimates of direct and indirect employment coefficients do not provide conclusive evidence on long-term employment effects: for some countries the inclusion of indirect employment coefficients improves the relative ranking of a given industry, while in others the position does not change materially. The results are sensitive to particular circumstances, since calculation of the total employment coefficient is based on assumptions about responses in the form of investment in other branches which may or may not occur. An indiscriminate expansion of resource-based industries for the sake of processing raw materials is likely to have a negligible effect on unemployment and the labor market. But some of these industries may provide the opportunity to establish mutually supporting, economically viable production lines and subsidiary activities--an interrelated industrial complex. Little is known at present, however, about the requisite combination of industries for integration that would prove viable in developing countries with access to foreign markets, technology and finance.

Social Objectives

Industrial development is indispensable for economic and social progress, and is a precondition for raising levels of income and employment in developing countries. And the data in Table 2 above suggest that industry has often increased employment at faster rates than other sectors. Doubts have been expressed in recent years, however, about its social value. Briefly, the criticism of industrialization in developing countries takes two main forms: (a) industrialization has not led to a reduction in unemployment nor to a decrease in inequality; and (b) industry has been developed to the neglect of other sectors of the economy, especially agriculture, so that growth is not harmonious. Furthermore, industrial production has too frequently been geared to satisfying the demands of upper income groups, with consequences detrimental to employment generation, the equitable distribution of income and social justice.

Industrialization contributes most to social development when industry produces goods at low prices for broad strata of the population to satisfy their need for food, clothing, shelter, health and education. Industry should create employment opportunities directly through the choice of appropriate product-mix and technology, and indirectly by providing inputs for the expansion of other sectors, such as agriculture, construction and essential services. Increased productive employment and higher incomes for the poor will change both the level and rate of growth of demand for basic consumer goods and public services. This shift in the composition of demand should

induce a shift in the pattern of production towards goods that may be more suitable for production on a relatively small scale. This may tend in turn to generate higher levels of productive employment, to the extent that the new product mix is characterized by greater labor-intensity.

Industrial Technologies

The technological basis for industrial development has recently been the subject of much study and discussion, especially in relation to income and employment generation and other issues arising in connection with social objectives. The focus has been on the choice of appropriate technologies and their development, transfer and adaptation. Quantitative measures to determine this choice have generally been expressed in terms of factor-intensity and productivity. An important aim is to reduce the capital-intensity of industrial technologies in the developing countries; but this may be constrained by fixed factor coefficients, or by distortions resulting from government policies, or this aim may be subordinated to other considerations.

The term "appropriate technology" for the developing countries is often thought to mean simple, labor-intensive technology, intermediate rather than advanced. This does not imply, however, that all advanced technologies, meaning mainly capital-intensive technologies transferred from the developed countries, are necessarily inappropriate. Such technologies may be appropriate in many cases, especially in some of the heavy industrial sectors. Social objectives other than economic efficiency and income growth are included in the concept of appropriate technology: employment generation, improved working conditions, provision of basic needs, and an equitable distribution of income are also involved. Appropriate technologies will differ from country to country depending on the differences in the weights given to these various factors.

In any case, appropriate technology involves much more than a choice of labor-capital proportions for a given process. Labor and capital are not homogeneous production factors; there are many types of capital goods, some serving just one function, but many having alternative functions. Skilled labor inputs are human capital; capital can also be thought of as embodying a past labor content. This implies that capital-intensive technologies may not create less employment than labor-intensive technologies when using capital goods with a high labor content. Furthermore, for a given capital-intensive technology the induced rate of savings may be higher than for an alternative labor-intensive technology, given higher marginal savings rates for corporate or government owners than for industrial workers and small enterprises. Factors such as scale, capacity utilization, and plant location also need to be evaluated. And indirect effects

on the choice of technology, especially through the use of intermediate inputs, need to be considered. For instance, the cost in foreign exchange of imported inputs can be viewed , under equilibrium trade conditions, as creating a need for an equal amount of exports needed to pay for these imports. In turn such exports, which in terms of comparative advantage are likely to be relatively labor-intensive, would generate additional employment. Thus, indirectly, the employment effect of using imported inputs might be quite high.

From the point of view of output, appropriate technology also involves many choices, since technology and product alternatives are often closely linked. For example, in providing an appropriate internal transport system there may be a choice between rail and road, between luxury and simple cars, between cars and bicycles. For many manufactured goods, labor-intensive production providing goods meeting basic needs could be an alternative to capital-intensive production providing sophisticated goods to meet the demand of high income groups. Technological choice may also be influenced by differences in product quality. Technological choice is also linked through consumer demand to income distribution: if the rich consume more capital-intensive goods than the poor, a more equitable distribution of income may lead to increased demand for labor-intensive goods and greater employment.

Clearly, the assessment of appropriate technology is not an easy matter. Cost-benefit analysis and shadow pricing can help, but in many cases the number of relationships involved makes quantitative analysis difficult, especially when several activities are linked. Besides the difficulties of finding the right criterion for assessing appropriate technology (and those related to the interdependence of activities), the acquisition of information on alternative techniques often presents problems. Such information is often only found through laborious research, and the cost of this may be quite high.

A consistent approach to the choice of technology. A comprehensive approach to the choice of industrial technology entails seeking and organizing technological and economic information in such a way that an evaluation can be made of the techniques available. It is possible to devise a scheme of investigation and to determine the least-cost technology in particular industrial processes. Thus, in each industry to be considered the objective is to identify a range of techniques that are expected to be economically efficient in the environment of developing countries. The choice ideally should be extended to include various mixes of different sub-processes to meet a diversity of needs.

This may be formally illustrated. A production process, in general, consists of a number of separate, identifiable operations or

sub-processes, and each of these sub-processes may be performed by different methods or "sub-techniques." In the brewing of beer, the intake of raw materials, fermentation, and beer filtration would be examples of separate sub-processes that can be carried out by different sub-techniques. All of these sub-processes in the right sequence make up the production process, and a combination of them forms a complete technique for that process.

Suppose that the production of a certain commodity on a certain scale can be arranged by using two distinct techniques that are observed to be in use. Each production process consists of three separate sub-processes, A, B and C, so that both the two observed techniques consist of three sub-techniques. These two techniques with their sub-techniques may be represented as follows: A_1-B_1-C_1 and A_2-B_2-C_2. If it is assumed that the sub-processes are separate and distinct, the total number of techniques actually available is greater than the number of techniques observed to be in use. In this example, the total number of techniques is eight--two of which are the observed ones and six of which are synthetic in the sense that they are put together by mixing the sub-techniques that have been observed. For instance, A_1-B_1-C_2 is one synthetic technique; A_1-B_2-C_1 is another. It is necessary to have some way of making the technical and economic data pertaining to these alternative technologies commensurate so that they can be compared. This can be done by using the discounted-cash-flow methods of obtaining new present values for each of the alternative technologies. The procedure is then akin to that of project appraisal--except that it requires the meticulous and complete evaluation of a large number of alternative technologies.

The methodology described has been applied to identify the scope for the choice of industrial technologies in 12 industries: footwear, brewing, maize milling, iron foundry, sugar, leather tanning, fertilizer, cotton cloth, bricks, machine tools, bolts and nuts, and corrugated paper board. Some results of these studies may be summarized briefly:

(a) A significant range of technically efficient technologies exist in virtually all industries studied.

(b) In some cases--footwear, sugar (in some circumstances), leather tanning and brick-making--the optimal technology in specified environments of developing countries was also a labor-intensive technology, even when the evaluation was made using market prices.

(c) In most of the studies an examination of the variations in profitability among technologies, and the corresponding variations in employment and investment costs, showed that the variations in profitability were much narrower than those in employment and

investment costs. An important implication of this finding is that insofar as there is a conflict between employment and profitability, the economic penalty for choosing the employment-generating technology would not seem to be very great.

(d) Even in a very capital-intensive industry, such as the fertilizer industry in the production of ammonia and urea, employment possibilities can be related to using marginally less capital-intensive methods and thus freeing investible funds which, in principle, could be deployed to provide additional employment in other activities.

A few of these studies are examined here to highlight important findings. In the study of footwear, considerable attention was given to the design of a factory capable of producing 300,000 pairs of men's shoes per annum. These shoes had leather uppers and cemented-on synthetic unit soles. In considering the factory design, 48 individual processes (work stations) were identified; at each station, where possible, a machine-intensive and a manual-intensive process was identified together with a process of intermediate intensity. By grouping the work stations according to stages of production, the number of separately identified technologies came to 486. By the use of the prices of 1972 in Ghana, an economic evaluation of the 486 technologies established that, at discount rates of both 10 and 20 percent, the least-cost technology would fall between the most machine-intensive and the most manual-intensive technologies, but would be nearer the latter in terms of investment requirements and employment. Although the variations in capital and labor inputs ranged down to 49 percent of the investment required for the most machine-intensive process, and up to 141 percent of the labor force required for the most capital-intensive set of operations at the labor-intensive end of the scale, there were no fewer than 430 technologies for which the net present value (at 10 percent) was within 2 percent of that associated with the most profitable technology. Moreover, the most manual-intensive technology was included in this number. When the discount rate was 20 percent a similarly high proportion of the technologies also had a net present value that fell within 2 percent of that of the most profitable.

The production of ammonia and urea was deliberately included in the studies in the hope that light could be thrown on the possibilities for factor substitution in a generically capital-intensive industry. The evaluation of relevant technologies concentrated largely on modern, highly capital-intensive technologies and Indian conditions in the early 1970s. It is worth noting that even here the variation in investment requirements across technologies was greater than that in profitability. Thus, an examination of 11 technologies, ranged in ascending order of fixed capital per process labor, suggested that the tenth would be the most profitable at discount rates of 10 and

20 percent in the production of urea in Indian conditions. None of the technologies would offer much employment. The fourth technology would, however, cause the investment cost to decline by some 13 percent compared with the tenth, but profits were only 6 and 3 percent less at discount rates of 10 and 20 percent respectively. As the difference in capital in the respective capital-labor ratios was more than ₺ 7,000 per man, it might be desirable to use a somewhat less capital-intensive method of producing urea and to use the investible funds thus saved elsewhere to provide additional employment.

In a footwear study a comparison was made, in Ethiopia, of the respective economic merits of producing 1.8 million pairs of men's shoes per annum: (a) by a single enterprise which, by producing 7,200 pairs of shoes per day could satisfy the entire requirement; (b) by 6 enterprises, each producing 1,200 pairs per day; (c) by 36 enterprises, each producing 200 pairs per day; and (d) by 1,200 enterprises, each producing 6 pairs per day. At both market and social prices the economic superiority of the single large factory was quite pronounced. The introduction of wider social considerations than those normally included in social cost-benefit analysis would make the establishment of 6 enterprises at different locations in the country a possibility, but the economic performance of the smaller enterprises would make it difficult to justify their establishment in any circumstances.

A similar comparison between factories of different size designed for African conditions to produce 28 million square yards of cotton cloth per annum had a broadly similar result: the economic advantage seemed to lie substantially with the modern technology. Taken together, the sugar, footwear and textile studies do not rule out intermediate technologies. They do, however, stress the importance of a careful and comprehensive consideration of alternatives; the failure to give the alternatives proper attention vitiates much of the recent work on appropriate technology.

The study on footwear illustrates another, frequently raised question. It is often suggested that technology is specially sensitive to the requirements of export markets, and that in particular production for export necessarily means the use of sophisticated technology. An examination of Ethiopian and Ghanaian footwear production and of the British market for imported footwear suggests that this is not universally so. For a well-specified product--men's leather-upper, cemented-on sole shoes--it was shown that the use of technology appropriate to the United Kingdom market in Ethiopia and Ghana would make it possible for these countries (at least in the conditions that prevailed in the early 1970s) to produce shoes that would be competitive with British production, even when

allowance was made for transport costs. It was shown further that if the technologies chosen were appropriate to Ghana and Ethiopia, the price competitiveness of Ghanaian and Ethiopian shoes in the British market would be somewhat increased.

The studies discussed can be distinguished from most of the literature on appropriate technology by the logical rigor with which they have been conducted. Much of this literature is characterized by more or less technical description--this is particularly true of technologies that are thought to be appropriate in some broad sense for the rural areas--and frequently by the complete absence of serious economic evaluation, either at market or social prices. More recently, the range of considerations has widened to include the environment. A number of interesting, additional dimensions have emerged as a consequence, including attempts to define environmentally sound and economically appropriate technologies, and the consideration of such questions as whether the cost of "purifying" alternative technologies significantly affects the rank ordering of technologies from what it would be if environmental considerations were ignored.

Rural Industry

Rural industries have advantages for national development with respect to their use of less expensive technology or machinery per unit of output, and per unit of labor. Rural areas offer less costly land (20 to 50 percent of urban land costs), buildings (50 to 75 percent of urban construction costs and less stringent building regulations), and often waste-disposal systems. Rural areas also can sustain the use of lower levels of technology if the production is geared to the less sophisticated needs of large rural masses. The development of rural industries would also be a more direct approach than reliance on the trickle-down effects of growth to reach the rural masses who represent the great majority of the poor.

Experience in the promotion of rural industrialization has been limited, however, and not all efforts have been successful. Among the difficulties encountered have been: 1.) The unresponsive nature of government administrative structures. Government ministries are organized along sectoral lines and they are geared largely to the conventional pattern of development in the industrial sector. Administrative structures and authority are not sufficiently decentralized in a number of countries. 2.) Inadequate allocation of resources by Governments to carry forward integrated rural development programs: rural industries require the simultaneous development of other sectors of the rural economy. 3.) Rural industrialization needs to be integrated with rural development programs, on the one hand, but also with national industrial development programs, on the other. Techniques of regional and area planning are most likely to help in

achieving integration. Such techniques are also used in rural spatial planning. The identification of growth centers where adequate infrastructure has developed, or is being planned, would greatly enhance the effectiveness and viability of rural industries. However, regional or area planning is still in its infancy in most developing countries.

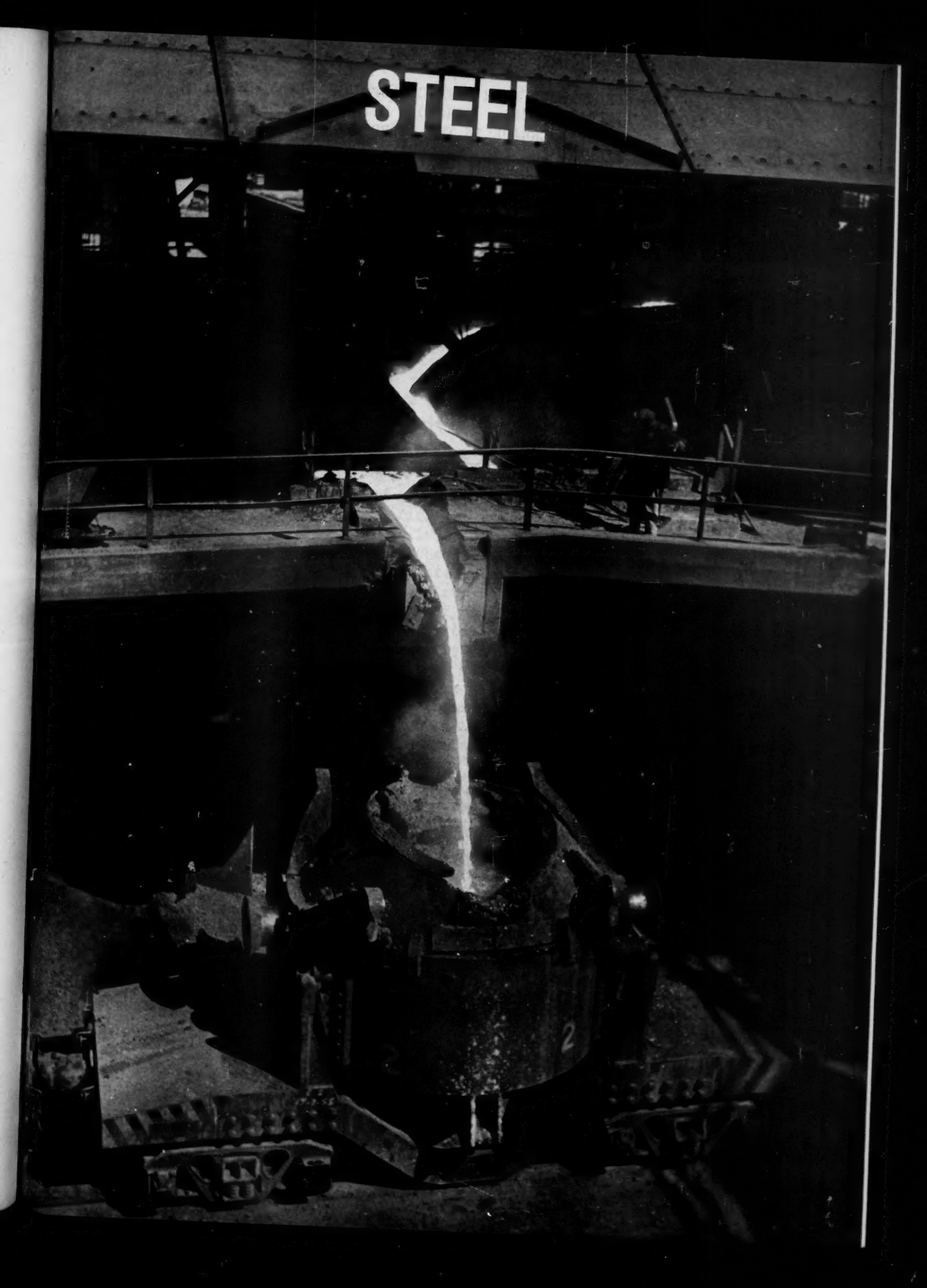
Added to these problems is that of understanding the nature of rural industrialization. A too narrow interpretation has often led to the promotion of only village crafts, or industries and services to achieve village-by-village self-sufficiency. This in itself will not achieve the objectives of employment promotion and income redistribution. Options should be kept open for a variety of sizes and technological levels of industrial enterprises to be located in rural areas. The reason for such a limited program may be that Governments have tended to see rural industrialization as a question of large versus small-scale enterprises. The possibilities that a variety of industries can be located in rural areas, and that technological dualism may be healthy, do not seem to be recognized.

Programs of rural industrial development now in operation in different countries fall into three categories: (a) Those that are nation-wide and cover rural areas in all or most provinces of the country, as e.g. in India, Iran, Kenya, Malaysia and the United Republic of Tanzania; (b) those that are experimental or pilot in approach and that cover a few selected areas, regions or provinces, as in Mexico; and (c) those that form part of the effort to promote small-scale industries and handicrafts. These are located mainly in rural areas, but development efforts should not be biased in favor of rural areas (e.g. in Bangladesh, Nepal and Pakistan).

Ingrained in all rural development programs is undoubtedly the aim of bringing the benefits of urban life (education and health services, cultural and social activities, and representative institutions) to rural residents. However, most integrated rural development programs do not as yet include spatial planning, and they are not fully integrated with regional planning efforts. Such an approach would entail a concept of rural-urban continuums, in which each stratum of locality would have a particular role to play in industrialization. The upgrading and integration of local factor endowments at each stratum in order to approach urban levels would help the industrialization process. There appears to be a growing interest in planning industries on the basis of rural-urban continuums. In the present industrial structure of China, large-scale industries operate in cities such as Shanghai and Canton, and medium-scale enterprises operate in almost all cities. In addition, there are numerous small rural commune industries and small urban cooperative industrial enterprises. Its training systems, its R and D and diffusion systems, and its industrial planning mechanisms take fully into account the contributions of industry at each level.

India is emphasizing a block-by-block planning effort in its Sixth National Development Plan (1977-82) for about 5,000 development blocks, each of which covers an average of 100 villages and several levels of localities in a rural-urban continuum. At the national level, this approach will emphasize area planning for the first time as distinct from sectoral planning. Pakistan, in its rural development program has developed two levels of concentration, primary units at a "homogeneous community" level, and the markaz (with a service area of 50 to 60 villages) where agro-based industries, machine workshops etc. are located. There were about 138 such markaz in 1977, and a total of 625 to cover 45,000 villages is planned in the future. Kenya has a rural industrial development program that involves the establishment of development centers for rural industries; 21 of these are planned. This program will become the base for assisting industry in small centers through extension activities. In Mexico the pilot experience of one state (Jalisco) shows a similar trend; there attention is given to three levels. The first level is in the city of Tuxpan where larger, concentrated workshops have been established averaging 32 workers each, with an investment of 50,000 pesos per worker. The second level includes the small towns of Copala, Tonila, San Jose de la Tinaja, where attention is given to production to meet local needs (cheese, brown sugar, sausages, bread, shirts, sweaters etc.). The third level is in the small villages, particularly where unemployment is felt most.

[Extracted from Chapters 7 and 8, World Industry Since 1960: Progress and Prospects, United Nations Industrial Development Organization, New York, 1979. U.N. Sales Number E.79.II.B.3.]


STEEL

HOT MELTED STEEL FLOWS FROM FURNACES OF THE VOLTA REDONDA MILL IN RIO DE JANEIRO, BRAZIL. (PHOTO: USIS RIO DE JANEIRO.) STEEL OUTPUT IS ON THE INCREASE IN THE THIRD WORLD, AS IS SHOWN BY THE FOLLOWING FIGURES FOR THE DEVELOPING COUNTRIES FOR 1960 TO 1977, AND THE ESTIMATES OF FUTURE CAPACITY.

Steel Trends in Developing Countries

1960	Steel Capacity* (Thousand Metric Tons)	Steel Production* (Thousand Metric Tons)	Share of Consumption (Percent)	Net Steel Imports* (Thousand Metric Tons)	Apparent Consumption (Thousand Metric Tons)
1960	10,000	8.700	41.4	12,300	21,000
1965	20,000	16,100	50.2	16,000	32,100
1970	28,000	21,600	53.2	19,000	40,600
1977	58,000	41,700	60.9	26,800	68,500

*Excludes mainland China

Crude Steelmaking Capacity, Year End
(Million Metric Tons)

	Estimated 1978	Projected 1980	1985
Total	64.0	75.9	112.0
Latin America	30.5	36.5	56.0
Brazil	14.0	15.0	25.0
Mexico	9.0	10.0	13.5
Venezuela	1.5	4.0	6.5
Argentina	4.0	5.0	7.0
Other	2.0	2.5	4.0
Africa	1.7	3.0	7.0
Algeria	0.6	1.0	2.0
Other	1.1	2.0	5.0
Middle East	4.6	4.7	7.2
Iran	2.0	2.0	2.0
Egypt	1.8	1.8	2.2
Saudi Arabia	NEGL	NEGL	1.6
Other	0.8	0.9	1.4
Asia*	27.2	31.7	41.8
India	13.5	14.3	19.0
South Korea	7.3	8.0	10.5
Taiwan	4.0	5.0	7.0
Indonesia	1.0	2.0	2.0
Other	1.4	2.4	3.3

*Excludes Japan and China

Estimates of the National Foreign Assessment Center, as of July 1979.

An Engineering-Economic and Manpower Analysis for a Steel Plant In Nigeria

Okuwese Ozoro

[The undertaking of an integrated iron and steel industry in a country where there has been none requires careful planning for its success. A Nigerian discusses some of the considerations involved for his country--size of plant, maintenance, and especially the advance training of skilled personnel.]

The Nigerian government has made a policy decision that, considering the expected growth of the economy and cost of imports and other vital national interests, it is in the overall interest of the country to build an integrated iron and steel plant in Nigeria. The decision raises many questions that touch on the problems of public investment in a developing country. Is the country well advised to undertake the necessarily vast capital investment? Is the raw material base adequate to establish the industry and, if not, how would the importation of raw materials to operate a steel industry compare with the import of finished steel products? It takes several years to plan and establish a steel industry; hence, the size of plant chosen now may be outgrown by demand before it is fully operational. How, therefore, is the demand expected to grow over a reasonably long period in the future, and what capacity of plant would be optimal in meeting that demand? Assuming that a plant of a certain capacity has been chosen in accordance with estimated demand, where should it be located, and why? What problems are raised by choice of technology, and by the ways of providing skilled manpower for the operation of a projected plant? These are some of the questions that must be answered, or at least studied with a

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view to finding some of the answers, to justify a very large public investment of the cost required for an integrated iron and steel complex.

Since Nigeria presently has no iron and steel industry, the manpower requirement of such a plant has been estimated by "international analogy", as UNIDO calls it. That is, the manpower patterns of other countries have been studied on the assumption that the type and quantity of skills that would be needed in the Nigerian plant do not differ substantially. While data derived through international comparison may not be completely applicable in a given development setting, they can at least provide reference points for the guidance of manpower planners. Many projects are undertaken in developing countries without adequate prior knowledge of the type and quantities of skills required, and of how those skills are to be phased in with the project. This has very often meant that thousands, even millions of dollars worth of scarce capital equipment either cannot yield adequate returns or is totally wasted; skilled manpower is frequently an even greater bottleneck to production than capital or materials shortages.

[Editorial Note: The original study is a carefully composed, highly integrated presentation which cannot be conveyed in these excerpts. What follows is a sampling of topics of potential interest.]

Nigeria's Probable Steel Demand in 1985

Typically, a modern steel plant takes about five years to construct in a developing country, and 3-5 more years to achieve full capacity production. Thus, in designing the capacity of a steel plant begun in 1975, for example, it is necessary to estimate probable steel demand in 1985 and beyond.

Several forecasting techniques have been developed. For short- and medium-term forecasts, it is common to fit a linear curve to past data and extrapolate it forward. However, Nigeria is unlikely to follow a linear trend over a long forecast period, given the rapid pace of development that appears attainable. Alternatively, steel consumption can be related to a macro-economic variable such as GNP or GDP; some use multiple correlation to relate steel consumption to several economic variables such as industrial production, construction and gross capital formation. The main difficulty here is that the macro-economic variables are themselves inherently difficult to forecast over a long period of time, and given the inadequacies of macro-economic data for Nigeria this method can only produce very crude estimates. A simple version of this method will be used.

Two other methods are more practical. The first method is that of historical analogy. A more advanced country is selected which at some period in the past had attained a level of economic development similar to Nigeria's. The steel consumption of the more advanced country at a later stage of development is then imputed to Nigeria at a future date. For plausible results, both countries should be fairly similar geographically and economically. Second, steel demand may be estimated from "end-uses", by estimating the future growth in each of the economic sectors consuming steel and their steel requirements at a given date. Then a total figure for the economy is calculated. In Nigeria's case, where patterns of steel consumption are not well established, the growth rates in the steel-using sectors are difficult to estimate, and a little crystal gazing is inevitable.

In 1970 Nigeria's direct steel consumption according to U.N. statistics was 466,000 tons. Assuming that steel consumption approximately doubles in every eight years in most developing countries, a rough estimate could be obtained for several years ahead. This trend is reasonably confirmed for Nigeria's imports since independence. On this basis the following pattern of direct steel consumption may be expected:

1970 -- 466,000 tons
1978 -- 932,000 tons
1986 -- 1,864,000 tons

Assuming that 80% of direct steel consumption should be domestically produced, a plant capacity of about 1,500,000 tons rolled steel would be required.

Brazil is a country which has passed a state of development that Nigeria may reasonably be expected to attain in 1985, and which has fairly close similarities. Both grow the same range of tropical crops--cocoa, cotton, rubber, coffee, palm products, ground nuts, etc.--and both are major exporters of some of them. Brazil is a larger country and has more known mineral resources, especially high grade iron ore; but to balance this, Nigeria produces and exports far more high grade crude oil. In 1971-72 Brazil's economy grew at about 11% while Nigeria's grew at about 12%.

Assuming the population of Nigeria in 1970 to be about 60 million and growing at 2.3%, it may be expected that Nigeria's population in 1985 would be about 84 million, which is very close to Brazil's population in 1965. Nigeria's GDP in 1971-72 was about N3,107 million, i.e., about $9,231 million. If an annual growth rate of about 8% up to 1985 is assumed, the GDP in that year should be about $25,350 million; and assuming 95% of the GDP is GNP, then Nigeria's GNP in 1985 is about $24,000 million. This is very close to Brazil's GNP in 1965. On the basis of these similarities, one

may impute Nigeria's probable steel consumption in 1985 as 3,082,496 ingot tons, (i.e., about 2,400,000 tons of rolled products).

Brazil, 1965	Nigeria, 1985
Population: 82,200,000	84 million
GNP: $25,900 million	$24,000 million
Per Capita GNP: $308	$277
Total Steel Consumption, Ingot Tons: 3,200,000	3,082,496 tons
Per Capita Steel Consumption: 44 kg	37 kg

An empirical study by the United Nations Economic Commission for Africa related steel consumption to GDP and gross capital formation. If S is steel consumption, and p the proportion of GDP in gross capital formation, then S in kg is given by

$$S = GDP\ (0.06 + 0.03p)$$

where GDP is in U.S. dollars. Assuming Nigeria's GDP in 1985 as estimated above, i.e., $25,350 million, and suppose p = 0.20, then S = 3,040,000 metric tons of total steel consumption, of which 2/3 may be taken as direct steel consumption, i.e., 2,006,400 tons. Domestic production of 80% of direct steel consumption would require a plant capacity of about 1,600,000 tons.

The grand total by direct estimation of end-uses of steel in each sector of the economy [details omitted here] comes to 1,598,265 tons. An alternative way to estimate probable demand by end-uses is to look at the probable capital investment pattern in economic sectors by 1985, and to calculate the steel content by assuming 0.36 kg per U.S. dollar of capital investment. The total estimated in this way is 2,540,000 metric tons.

Summary of Estimates

(1)	By eight year growth pattern:	1,864,000 metric tons
(2)	By analogy with Brazil:	2,438,000 " "
(3)	By gross domestic product:	2,006,000 " "
(4)	Direct estimation by end-uses:	1,598,265 " "
(5)	Estimate by probable capital investments:	1,676,400 " "

These estimates indicate that by 1985 Nigerian consumption of rolled steel should be in the range of 1.5-2.5 million tons.

Strategy for Phased Development. The choice of plant size is a complicated question. i) Under-utilization of capacity in a plant which is too large can result in very high production costs.

ii) But if a plant is too small for its market, the cost of building additional capacity later to meet an increased demand will be more expensive than if excess capacity had been built into the initial plant size. iii) There are considerable economies of scale in steelmaking processes which favor larger plants. iv) But these are offset by the difficulties of learning new techniques; a developing country just beginning to establish a steel industry would be well advised to consider starting small.

In view of these considerations, one has to strike a balance of some sort. A phased development would appear to be the best strategy. The development is envisaged in three phases as follows: 1.) Start with a plant of one million tons of rolled products, with a built-in excess capacity in the more expensive units such as the rolling mills for items that are heaviest in demand. The items in heaviest import demand have been sections, bars, rods and other structural products, tubes and sheets. 2.) In phase two, one or two things may happen. It may be necessary to expand iron and steelmaking capacity so as to utilize fully the rolling mill capacity if demand for existing rolled products grows rapidly. It may also be necessary to install new product lines and thereby raise the overall capacity to about 2.5 million tons or more. At this stage, the size of the expansion will depend on whether it is judged to be in the overall interest of the economy to concentrate all major steel production in one large plant or to distribute it between various industrial centers. Of course, it is always possible to have small electric furnace steelmaking plants very close to market centers wherever feasible. Such small plants will be required for special steels, such as stainless and tool steels, or steels for special machine components. 3.) A final phase of expansion should probably exhaust the capacity of the site, considering the desireability or otherwise of distributing major steel-producing units throughout the economy.

Therefore, planning and further analysis are based on a plant capacity of 1 million tons of rolled products. This would require about 1,050,000 tons of crude steel assuming continuous casting is used in place of the traditional blooming mill. The one million tons of rolled products may be distributed as follows:

Blooms - Medium sections - 150,000 tons
Billets - Bars, wire rods, torsteel, etc. - 300,000 tons
Slabs - Plates and skelp for tubes - 250,000 tons
Sheets - Plain and galvanized - 300,000 tons

The Organization of Maintenance

The proper maintenance of equipment in a steel plant is a vital vunction, and it is one which affects the manpower requirements very considerably. Generally, an integrated steel plant in

Nigeria must provide all its own maintenance services. An essential function of maintenance is to replace or repair worn out components. Now, to carry all components necessary for maintenance entails a very large inventory and accurate inventory control. Quite often the foreign exchange for purchase of needed parts is not available reliably, or on time, in a developing country. One alternative is to manufacture as many components as possible. As a rule, the raw materials such as alloy steels, forged steel bars, etc. from which many components are made are relatively cheap, unlike the finished items. Furthermore, the experience of actually manufacturing spare parts provides excellent training in various technological processes. The alternative of making as many spare parts as possible is recommended. This choice clearly affects the manpower requirement in a very profound manner, because of the highly skilled jobs that would be entailed.

But how is the actual maintenance organized? Should there be one central maintenance organization with satellite units serving various departments, or several independent maintenance shops for each of the major sections of an integrated steel plant? What is to be the organizational structure for manning the system? It is important whether for any chosen structure there is to be a maintenance geared to repairs after failure, or designed to prevent failure as much as possible while able to effect repairs to any failures that may occur as rapidly as possible.

The following maintenance structure is proposed. There should be two central workshops, mechanical and electrical, equipped to undertake all major repairs for the entire steel plant. That is, major items of repair should be sent to the appropriate workshop which should be equipped to manufacture as many items as possible. In addition to these two central workshops, very important units such as the rolling mills, blast furnace, coke ovens and by-product plants should have small workshops attached to them to undertake routine production maintenance. This production maintenance occurs in every shift, and deals with all jobs that are of such a minor nature that they can be done quickly, so that work is interrupted at minimum cost if at all.

The overall philosophy should be preventive maintenance. This means that a detailed long-range plan is made such that certain stipulated overhauls of differing extent are undertaken at preassigned periods, but such that production is interrupted as little as possible. The long range plan can cover as long as three years; the maintenance work goes on every day, week and month of the period covered. Such an arrangement requires very careful planning, supervision and coordination at all levels of the enterprise. The trouble is well worthwhile for a developing country which must keep its huge capital investment in machinery operating at maximum efficiency in order to achieve best returns.

There are many odds against such an achievement, and strenuous effort to prevent expensive machines from becoming idle is one of the surest ways to fight these odds. One of the tragedies of development is the almost careless attitude to making scarce capital yield adequate returns. Eroding soils, stalled trucks, leaking roofs, prematurely run-down machines, unsafe bridges, clogged-up irrigation ditches--all testify to the same pervasive and paradoxical trait: the inadequate care for existing capital in capital-poor countries. As Hirschman observes, "For maintenance to be effective, people must be made to act as though it had to be undertaken at precise intervals, suppressing their better knowledge that deferment by a day, a week or a month may not matter; they must organize this fiction, submit to it, and set up a signalling system to enforce it."

Overall Estimate of Manpower Needs

On the basis of Nigeria's demand for steel, it was decided that the country should produce 1 million tons of this expected demand for rolled products. The normal materials process wastage has been about 33%, but with continuous casting replacing soaking pits and blooming mill the wastage should be much less; about 95% efficiency of conversion is often quoted. On this basis a 1.05 million ton mill should should produce 1 million tons of rolled steel. A high assumption of labor productivity is made so as to keep the overall manpower low. This is done because the tendency in practice is for the number of men to grow, and if the plant starts with a low productivity target the trend will escalate the numbers. It is best to start with a minimum number of men so as to inculcate good working habits, and to increase personnel only after careful analysis of any demand for increased manning.

Assuming an overall labor productivity of 150 tons per man year, for 1.05 million tons of crude steel the "in works" manpower would be 7,000 men. Allowing another 1,000 men for administration, the total would be about 8,000. For a developing country this is a small number, but it is really not too bad. In India it is readily admitted that with good planning the public sector plants could have been manned with 9,000 men "in works" at the 1 million tons stage instead of about 15,000 men which actually obtained in most of the plants. Indian manpower figures are high partly because of the practice of providing helpers to skilled workers--one to carry his tool box, and another to hold job pieces, and so on. This practise is not recommended. Usiminas in Brazil is producing 1 million tons of flats with 5,900 men.

The "in works" personnel are tentatively distributed as follows:

5% Engineers/Managers
15% Technicians
45% Skilled
25% Semi-skilled/General Labor
10% "In Works" Office Staff

The percentages suggested for engineers, technicians and skilled workers are rather high for two reasons: to allow for sophisticated processes, and to ensure that high caliber personnel are available to absorb skills at the initial stages of the plant.

It is estimated that the following types of engineers and scientists are required: Mechanical, Metallurgical, Electrical, Chemical, Ceramic, Instrument, Fuel, Lubrication, Industrial/Production, Civil/Structures and Chemists. Nigeria now educates only Mechanical, Electrical and Civil Engineers; the other types will have to start training right away. After the engineers, the technicians are college diploma holders in various engineering fields. Some of the operatives are highly skilled men trained on the job, e.g., rollers, assistant rollers, and blowers. The largest single group of workers are the skilled men who are responsible for repairs and maintenance of machinery and equipment. The major skills are: fitters/machinists, electricians, blacksmiths, pattern amkers, core molders, tool and die makers, plumbers, welders/gas cutters, etc.

Time-Phasing of the Manpower Requirements

It is apparent that these various skills cannot all be recruited, trained and deployed at one point in time. The question, therefore, arises as to how these men are to be made available. This clearly involves the construction program of the plant and the commissioning sequence of the various plant units. The construction of modern large-scale industrial projects is a complex affair; in fact, so complex that special techniques (e.g. CPM and PERT) have been developed for planning construction sequences. What follows is a rough estimate to indicate how an actual program might look.

The construction sequences of an integrated steel plant could be done in several ways. For instance, it may be thought desirable to construct the whole plant so that units are commissioned within a few months or weeks of each other. This is usually the case when it is intended that the plant should supply all the inputs to its various units within itself, especially where reheating furnaces in the rolling mills have to be fuelled by coke-oven gas. In this situation, the coke ovens and blast furnaces are commissioned before the rolling mills. Another sequence is often called backward integration, which can be very piecemeal indeed. The long-range backward integration starts with rolling mills, which can start operation several years in advance of other units such as coke ovens, blast furnaces, ore and

coal-handling facilities, etc. But Nigeria is in a hurry, and the estimate is that the whole construction program should not take more than five years; it might be three years. The suggested construction sequence for the production units, then, starts with the rolling mills on the assumption that the plant location is to be near a gas field. The mills could be commissioned several months ahead of the blast furnaces and coke ovens since blooms, billets and slabs could be imported, reheated with natural gas and rolled to serve urgent needs of the economy, while the other units can be programmed to start all at once several months later.

The major advantage of the staggered rather than a simultaneous construction and commissioning sequence is really to stagger the demand for manpower so that their supply and training can be phased, with a consequent reduction of manpower bottlenecks. Hence, the construction chart is a valuable guide as to how the manpower system might be phased with construction schedules and commissioning of the units. When a plant unit is commissioned, half of the overall labor force should be in position. During the first six months they will be oriented and/or trained in a series of what might be called "dry runs" before actual round-the-clock production operation begins. The manning should remain at this level until the unit is producing at about or slightly above half capacity. It is estimated that this should occur at about 18 months from start-up. At this stage, the labor force should be increased to three quarters of its full strength, and again to remain there until the plant unit achieves about three quarters of its full capacity. The final one quarter of the labor force should be very slowly filled in. This procedure is to avoid unnecessary overmanning and resulting indiscipline and sloppy work habits. The result of the above phasing operations can be shown in charts indicating the distribution of engineers and technicians by plant units or departments through time, while another chart shows the corresponding distribution of craftsmen [omitted].

Managerial and Supervisory Training

Technical competence is the first major consideration. It is essential to select men who are educated and if possible have practiced the technologies associated with a steel plant. This is hard to fulfill in a country without prior steelmaking facilities. There are a few Nigerians working abroad in steel plants, but even if they can be persuaded to return home their numbers are insufficient.

There are two ways to tackle the problem: In such fields as mechanical, electrical and civil engineering where there are quite a few Nigerians in practice, either in government or industry, suitable inducement could be offered to attract them into the steel plant. Such persons should after selection be sent abroad to acquire experience in the operation of a steel plant, especially in

technologies to be employed in the proposed plant. They should first be exposed to the whole range of processes in a steel plant to acquaint them with the interconnected nature of steelmaking in an integrated plant; thereafter they should concentrate on some chosen aspect such as the LD process or rolling mills. Such training can be arranged with the technical partners in the steel project or through governments of appropriate friendly countries. On the other hand, in areas where there are extremely few Nigerians already qualified such as metallurgy and chemical engineering, a crash program should be initiated without delay to send young persons abroad to acquire basic technological education, to be followed by the sort of practical training outlined above.

The above program applies with equal force to supervisors as well as managers, with special emphasis on the particular responsibilities at each level. The problem of recruiting practicing technicians in mechanical, electrical and civil engineering is likely to be much less than that of engineers, since all Nigerian polytechnics offer technician courses in these fields. But there are no courses available in the country in metallurgical and chemical engineering, at either engineer or technician level.

The first prerequisite in planning for management or supervisory staff is to define the duties of each post very carefully, and to assess whether individuals occupying or likely to occupy each post have the requisite qualities of character and training to discharge those duties. Training should then be designed to either inculcate or reinforce the necessary skills according to the degree of deficiencies determined from the assessment. Lest training should be enshrined as the only God of good management, however, it is necessary to make a caveat. While training is extremely important it cannot of itself create good managers. Good managers evolve both from the training processes we have outlined and from a sensitive awareness and appropriate reaction to social, political, psychological, economic and other factors which no training program can possibly cover. [Descriptions of the requirements for training scientist-technologists, technicians, craftsmen, and operatives follow.]

Necessity for a training center. It is, of course, possible to have a training organization which simply arranges courses in suitable institutions or sends trainees abroad. But the situation in which the proposed steel plant will initially find itself requires a fully equipped technical training center designed to offer courses for technicians and craftsmen. It should also be capable of organizing courses on a short-term basis in various management and supervisory functions. The necessity for such a center is clear from our analyses of the training requirements: some of the technical courses are not now being offered, and no other enterprise would have the in-

centive to initiate training in some of them, e.g., the foundry trades. The steel plant will have to have a fully equipped school to operate these courses.

The technical training center should be erected as soon as the location of the steel plant is known. In my discussions with top management both in India and Brazil, it was pointed out that a common and sad mistake is to wait for several years after the plant is in operation before establishing a training center. The best policy is to have a fully equipped and staffed technical training center in operation at least three years before the steel plant goes on stream. It can then be used to train staff at the stage when such training is most critical. This has not been usual, and most experienced managers of steel plants in the countries visited regret a curious lack of vision on the part of planners towards this problem. All too often action is taken only when collapse is threatened by the lack of trained persons in various skills at the critical stages of establishing the steel plant. We strongly recommend that Nigeria should learn from the experience of other countries.

[Extracted from "An Engineering-Economic Analysis and Manpower Planning for Establishing an Integrated Iron and Steel Plant in Nigeria," Chapters 1,2,4,7 and 11, PhD Dissertation in Engineering-Economic Systems, Stanford University, Palo Alto, California, 1974.]

Note: Since the above was written, Nigeria has embarked on the construction of a steel industry. The steel journal, Metal Bulletin of Sept. 18, 1979 reports that plans are well underway for two large integrated mills. A blast furnace-based plant at Ajaokuta, with initial 1.3 million tons per year capacity, is due to start up in 1986, and may be expanded to 5 million tons by 1990. A direct reduction-based works at Warri will be commissioned in 1981 with 1 million tons a year capacity, which could later reach 3 million. Billets from these two plants will be sent to three inland re-rolling mills of over 200,000 tons capacity each. Meanwhile, Nigeria's consumption of imported products continues to rise, reaching 2.5 million tons in 1977.

Toward Radical Changes in Steelmaking

Julian Szekely

[This article outlines briefly the current technology used for making iron, steel, and standard steel products. It then describes several areas where radical new technologies have been tested and show promise.]

Current Steelmaking Technology: How it Works

There are five stages in conventional steel processing by which raw materials are converted to finished steel products:

- o Raw materials preparation and cokemaking
- o Ironmaking
- o Steelmaking
- o Casting and primary rolling
- o Finishing

It is customary to term the first four stages as the "primary end" and the last stage as the "finishing end." Consider each of these in turn.

Raw materials preparation processes convert the iron ores and the coking coal into forms suitable for ironmaking. The ores, essentially iron oxides containing some impurities, may be agglomerated into particles at least roughly the size of small marbles before they are introduced into blast furnaces. This is done either in pelletizing units (usually located at the mine site) or in sinterplants in which mixtures of fine ore particles, limestone, and other materials are made to undergo partial fusion.

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The coke, which serves both as a reducing agent and as a fuel in ironmaking, is manufactured from coal in coke ovens. Finely ground coal is heated in the absence of air to temperatures at which volatile matter, moisture, and some of the sulfur compounds are driven off. The result is metallurgical coke; the volatiles, known as coke oven gas, are also a valuable fuel.

Most ironmaking is done in iron blast furnaces, which are in essence tall vertical shafts up to 30 meters high and 10 to 15 meters in diameter. Iron in ore, sinter or pellets, flux (limestone), and metallurgical coke are charged (i.e. put in) at the top, while preheated air is blown into the system at the bottom. There is partial combustion of the coke, and the oxygen and minerals are removed from the iron ores, reducing them to metallic iron, during their descent through the furnace. The main products are molten iron (containing carbon, silicon, manganese, sulfur, and phosphorus), molten slag (waste material), and blast furnace offgas. Typically, a single such blast furnace produces some 1,000 to 10,000 tons of molten iron per day.

An alternative to the blast furnace, especially suitable for small-scale operations and where oil or natural gas are plentiful, is provided by "direct-reduction" processes. These are carried out in several types of furnaces in which iron ore pellets brought in contact with an ascending mixture of reducing gas in a counterflow arrangement. The product of direct reduction units is solid "sponge iron" which has to be melted and refined in electric arc furnaces to obtain steel. Typical direct reduction units produce some 1,000 tons per day. (At present less than 5 percent of the world's total ironmaking capacity is based on direct reduction.)

Steelmaking is the process of purifying the metal from the blast furnace or the direct reduction furnace--recycled steel scrap may also be used--by selectively oxidizing such impurities as carbon, silicon, manganese, sulfur, and phosphorus.

The open-hearth steelmaking process involves the treatment of hot metal and scrap in a shallow reverbatory furnace which is heated by burning oil or natural gas. The impurities are oxidized and withdrawn as slag and offgas. This is oldest of the currently used technologies, and it is rapidly fading in significance due to its high energy and labor requirements.

The dominant steelmaking operation at present is the basic oxygen process, in which molten iron and scrap are introduced into a pear-shaped vessel and then a supersonic oxygen jet is blown onto the bath surface. The oxygen reacts with the impurities to create

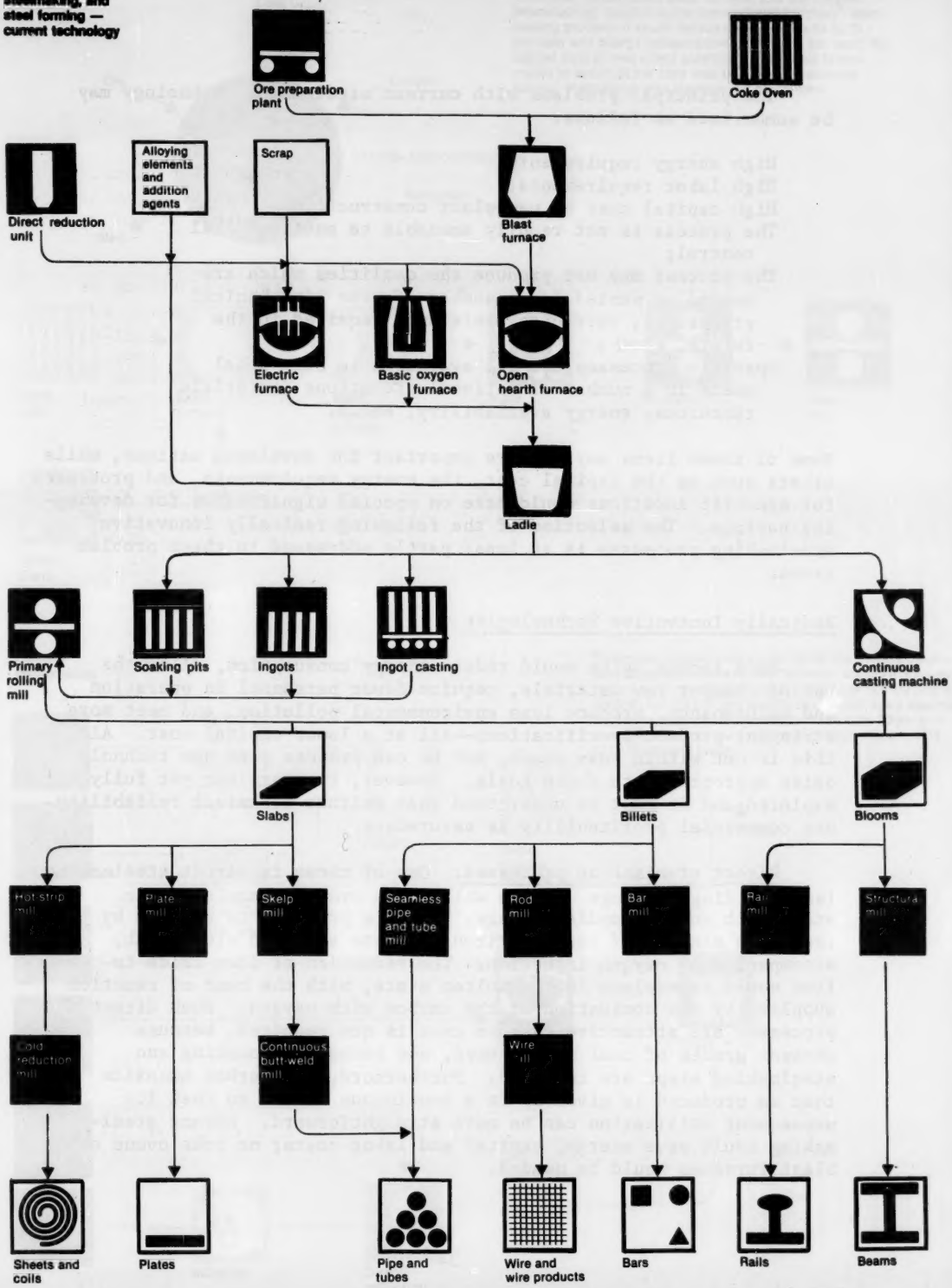
slag and offgas, and the refining is completed in less than 25 minutes, in contrast to several hours in the open hearth process. A variant of the basic oxygen process is the Q-BOP operation, which involves blowing oxygen and a coolant through the bottom of the vessel instead of from above.

Steel is also made in electric furnaces, which are attractive because they can accept charges ranging from 100 percent scrap to largely molten hot metal. Such a furnace consists of a cylindrical shell with a dished bottom which is covered by a removable roof through which graphite electrodes are inserted. The arc struck between these electrodes and the metal charge provides the thermal energy needed to melt the charge, and the impurities are oxidized by an injected oxygen stream.

Casting and primary rolling are carried out immediately after the steelmaking is completed. In conventional mills, the steel is formed into ingots which are processed into blooms or slabs at a later time in the primary (rolling) mills. If continuous casting a much more energy-efficient operation) is used, slabs and billets are produced directly as the new steel emerges from the furnace. The slabs and blocks (called billets and blooms) thus produced are converted to the final products in finishing mills, where these intermediate products are brought to the proper temperature in reheating furnaces and are then rolled in several stages (hot and cold strip mills, bar mills, and the like) into the finished shapes.

A typical integrated steelplant, comprising all the processes described above, is a very complex operation. There are some 40 plants of this type in the U.S., ranging in capacity from about one to eight million tons per year of finished product. Total U.S. finished steel production is now about 100 million tons per year. The average cost of producing one ton of steel in a U.S. plant is about $350, of which energy and raw materials account for 45 percent, labor for 35 to 45 percent, and capital service charges (including depreciation) 6 to 10 percent. To make one ton of steel in the U.S. requires 34 million B.T.U. of energy and 8.2 man-hours of labor. The book value of such a plant is about $120 per ton of annual output, but the replacement cost is about $1,500 per ton.

A detailed breakdown of these figures shows that 75% of the labor is required at the finishing end of the process, while 65% of the energy is consumed in coke-, iron-, and steelmaking. These figures have important implications for the objectives of new technologies with which one might wish to replace existing operations.


Ore preparation plant
Coke Oven
Direct reduction unit
Alloying elements and addition agents
Scrap
Blast furnace
Electric furnace
Basic oxygen furnace
Open hearth furnace
Ladle
Primary rolling mill
Soaking pits
Ingots
Ingot casting
Continuous casting machine
Slabs
Billets
Blooms
Hot-strip mill
Plate mill
Skelp mill
Seamless pipe and tube mill
Rod mill
Bar mill
Rail mill
Structural mill
Cold reduction mill
Continuous butt-weld mill
Wire mill
Sheets and coils
Plates
Pipe and tubes
Wire and wire products
Bars
Rails
Beams

The principal problems with current steelmaking technology may be summarized as follows:

High energy requirements;
High labor requirements;
High capital cost of new plant construction;
The process is not readily amenable to environmental control;
The process may not produce the qualities which are needed or wanted for a number of uses (mechanical properties, corrosion resistance required in the future, etc.);
Specific processes are not available to suit local needs in a number of national situations (materials resources, energy availability, etc.).

Some of these items may be more important for developed nations, while others such as the capital cost, the energy requirements, and processes for specific locations could take on special significance for developing nations. The selection of the following radically innovative steelmaking processes is at least partly addressed to these problem areas.

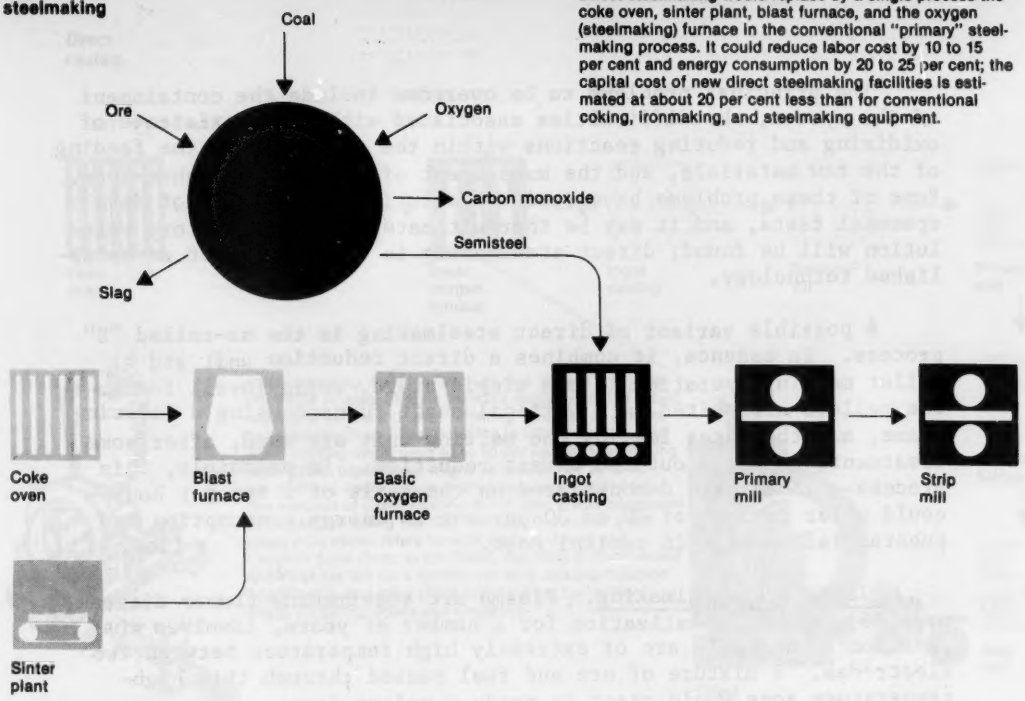
Radically Innovative Technologies

Such technologies would reduce energy consumption, allow the use of cheaper raw materials, require fewer personnel in operation and maintenance, produce less environmental pollution, and meet more stringent product specifications--all at a lower capital cost. All this is not within easy reach, but we can propose some new technologies appropriate to these goals. However, they are not yet fully explored, and it must be understood that neither technical reliability nor commercial profitability is assured.

Direct steelmaking processes. One of these is direct steelmaking (see top diagram, Page 35), in which iron ore is transformed to steel with no intermediate stage. This is proposed to be done by feeding a mixture of coal and iron ore into a molten steel bath, accompanied by oxygen injection. The reduction of iron oxide to iron would take place in the molten state, with the heat of reaction supplied by the combustion of the carbon with oxygen. Such direct processes are attractive because coke is not required, because cheaper grades of coal may be used, and because ironmaking and steelmaking steps are combined. Furthermore, the carbon monoxide that is produced is given up in a continuous manner so that its subsequent utilization can be more straightforward. Direct steelmaking could save energy, capital and labor costs; no coke ovens or blast furnaces would be needed.

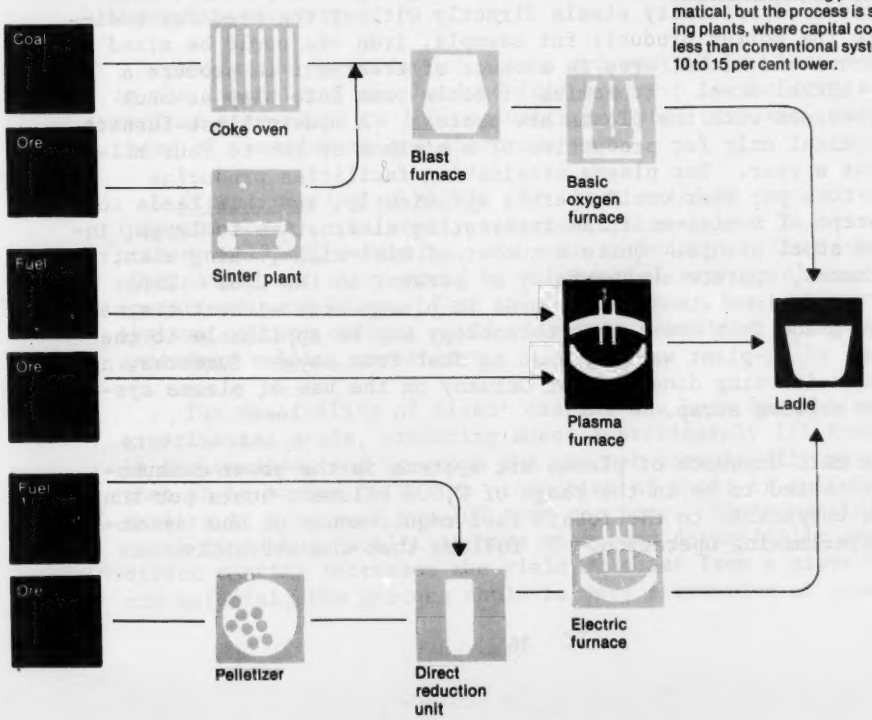
Direct steelmaking

Direct steelmaking would replace by a single process the coke oven, sinter plant, blast furnace, and the oxygen (steelmaking) furnace in the conventional "primary" steelmaking process. It could reduce labor cost by 10 to 15 per cent and energy consumption by 20 to 25 per cent; the capital cost of new direct steelmaking facilities is estimated at about 20 per cent less than for conventional coking, ironmaking, and steelmaking equipment.



Plasma steelmaking

Plasma arc steelmaking would substitute a single electrically powered furnace for the "primary" stages in the conventional steelmaking process. Energy savings are problematical, but the process is suited to smaller-scale steelmaking plants, where capital costs could be 10 to 20 per cent less than conventional systems and labor requirements 10 to 15 per cent lower.



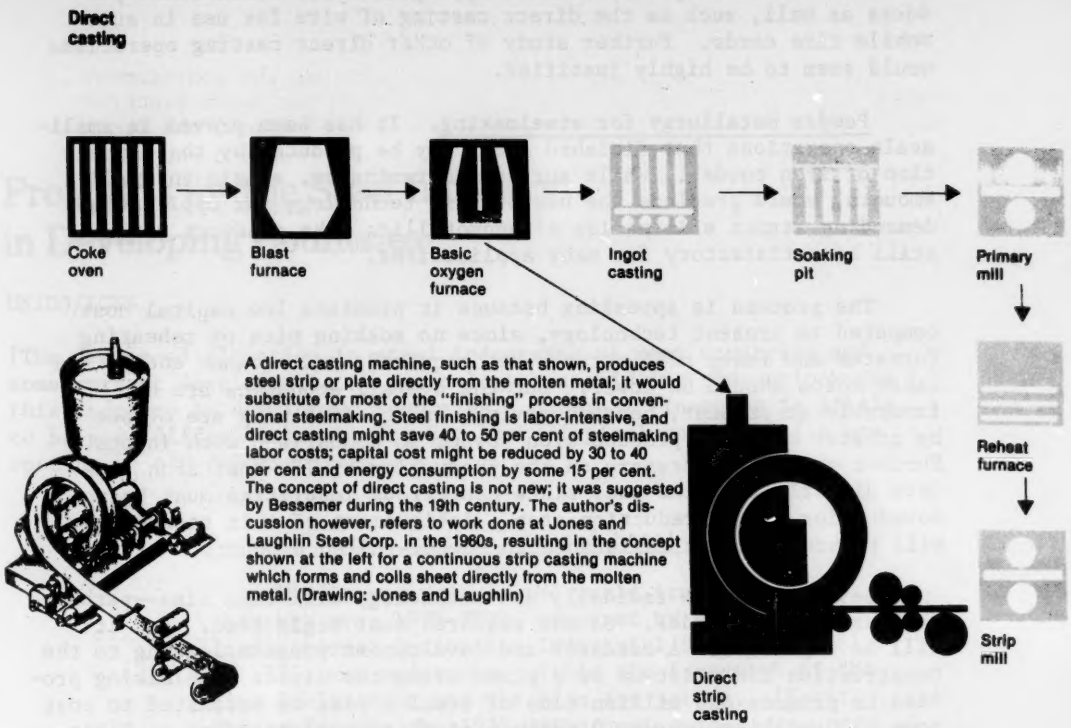
The principal problems to be overcome include the containment of the system, the difficulties associated with the coexistence of oxidizing and reducing reactions within the same vessel, the feeding of the raw materials, and the management of start-up and shut-down. Some of these problems have resisted solution in a number of developmental tests, and it may be that ultimately no satisfactory resolution will be found; direct steelmaking is definitely not an established technology.

A possible variant of direct steelmaking is the so-called "S" process. In essence, it combines a direct reduction unit and a pellet melting operation into a single stage, using fossil fuels. The pellets are melted in a vertical-shaft furnace using a reducing flame, and the gases leaving the melting unit are used, after some treatment, to carry out the direct reduction. In principle, this process--it has been demonstrated on the scale of 1 ton per hour--could offer savings of 20 to 30 percent in energy consumption and substantial savings in capital cost.

Plasma arc steelmaking. Plasma arc steelmaking (lower diagram, page 35), under investigation for a number of years, involves the creation of a stable arc of extremely high temperature between two electrodes. A mixture of ore and fuel passed through this high-temperature zone would react to produce molten iron.

This technology is appealing for several reasons. Its capital cost would be relatively low, since no coke ovens or blast furnaces would be required. Plasma arc steelmaking may make possible the manufacture of specialty steels directly without the need for additions to the molten product; for example, iron ore could be mixed with chrome and nickel ores in advance of treatment to produce a chrome-nickel steel. Economies of scale come into play at much lower tonnages with the plasma arc process. A modern blast furnace is economical only for production of a minimum of two to four million tons a year. But plasma steelmaking facilities producing 200,000 tons per year could operate efficiently, and this leads to the concept of a mini-mill, an interesting alternative to large, integrated steel plants. Quite a number of mini-mills, using electric arc furnaces, operate successfully at present in the U.S. Under certain conditions steel can be made in plasma arcs without the need for high-grade iron ores; this technology may be applicable to the recycling of in-plant wastes, such as dust from oxygen furnaces, as well; work is being done in East Germany on the use of plasma systems for melting scrap.

The main drawback of plasma arc systems is the power consumption, estimated to be in the range of 2,000 kilowatt-hours per ton which is comparable to the fossil fuel requirements of the conventional steelmaking operation. It follows that the attractiveness of



A direct casting machine, such as that shown, produces steel strip or plate directly from the molten metal; it would substitute for most of the "finishing" process in conventional steelmaking. Steel finishing is labor-intensive, and direct casting might save 40 to 50 per cent of steelmaking labor costs; capital cost might be reduced by 30 to 40 per cent and energy consumption by some 15 per cent. The concept of direct casting is not new; it was suggested by Bessemer during the 19th century. The author's discussion however, refers to work done at Jones and Laughlin Steel Corp. in the 1960s, resulting in the concept shown at the left for a continuous strip casting machine which forms and coils sheet directly from the molten metal. (Drawing: Jones and Laughlin)

plasma arc systems will depend critically on the cost of electric power compared to that of other fuels and also on the efficiency of waste gas recovery.

While the operation of plasma arc systems has been demonstrated in the laboratory, the hundred-fold scale-up to the projected commerical size of 50 to 100 megawatts may pose problems, including those of containment and electrode wear.

Direct casting of sheet. If sheet could be cast directly (diagram above), the costly intermediate stages of ingot casting, primary rolling, reheating, and some secondary rolling would be eliminated, and there could be substantial savings of capital, energy, operations, and labor. Even as a replacement for continuous casting systems, direct casting could eliminate reheating furnaces and some secondary rolling operations.

The feasibility of direct casting has been demonstrated on an experimental scale, producing sheet approximately 1/4 inch thick and 15 inches wide, and to prove the concept commercially requires only that it be scaled up to the production of sheet of satisfactory quality at a rate of say 100 tons per hour. Since capital costs for steel finishing facilities have increased dramatically and because direct casting increases the yield of sheet from a given quantity of raw material, the process could be very attractive at present.

The same concept may well be appropriate for other steel products as well, such as the direct casting of wire for use in automobile tire cords. Further study of other direct casting operations would seem to be highly justified.

Powder metallurgy for steelmaking. It has been proven in small-scale operations that finished steel may be produced by the compaction of iron powder. While surface contaminants, albeit in small amounts, would preclude the use of this technology for applications demanding strict elimination of nonmetallics, the products would still be satisfactory for many applications.

The process is appealing because it promises low capital cost compared to present technology, since no soaking pits or reheating furnaces and fewer mill strands are required, and because energy and labor costs should be lower. But the overall economics are not favorable at present, because savings in the finishing are offset by greater costs to produce iron powder in comparison with ingots. Further study is necessary on the production of low-cost iron powders directly from the ore, since nonferrous impurities must be removed prior to the reduction step. Achievement of this technology will reduce customer resistance to powder-rolled products.

Developing such radically new technology will take time--perhaps as long as two decades. So the research must begin soon. And it will be expensive. A research and development program leading to the construction and start-up of a plant using the direct steelmaking process to produce one million tons of steel a year is estimated to cost some $500 million; about 10 percent of this would be spent on laboratory-scale work. Later plants of similar capacity built after the technology has been proven should cost substantially less--optimistically $150 to $200 per ton of annual capacity for the primary end. Plasma steelmaking could probably be commercialized over a period of eight to 16 years, with research, development, and construction costs of $100 to $150 million leading to a full-scale installation. The development of direct sheet casting to full-scale operation would take about five years and a total of perhaps $50 million.

Some potentially attractive ideas have been discussed in this paper; the author is quite certain that many other new approaches could be developed, provided a better climate is created for innovation, research, development, and the implementation of research results through investment in new plants. If the case for the steel industry is perceived to be important, it would be necessary to devote substantial resources to new process development and to establish an appropriate new framework for it. This could be a very exciting and fruitful area for collaboration between industry, labor, the academic community, and government; indeed, such collaboration would be essential for the success of such a program.

[Extracted from Technology Review, Vol. 81, No. 4, February 1979, pp. 23-39.

Prospects for the Steel Industry in Developing Countries

UNIDO/ICIS

[The depressed situation in steel industries of many countries and some current developments in technology are shifting the outlook for this industry in developing countries. External financing is likely to be more difficult to obtain, but technological possibilities are opening up new opportunities.]

Recent Changes in the Iron and Steel Industry

The first study on the world iron and steel industry over 1975-2000, prepared by UNIDO's International Center for Industrial Studies (ICIS) in 1976, was undertaken within the framework of the Lima Declaration and the Plan for Action. [Note: This refers to the 1975 UNIDO Conference, which called for a 25% share of the world's industries to be located in developing countries by the year 2000.] Since 1976, however, changes have taken place in the steel industry which affect trading, the prospects for location, and the problems of financing. These have led the ICIS to prepare a new examination of the situation. During the second half of 1977 authoritative voices were heard affirming that the widespread recession in iron and steel production arose not from the familiar cyclic economic situation (which would have reversed itself by then), but rather from a structural phenomenon involving major transformations. This cast doubt on the reliability of the instruments forged during a long period of continuous growth for the measuring and forecasting developments in the industry.

New analyses suggest that we are entering a period of increasing uncertainty--uncertainty in fore-

Study prepared by the International Center for Industrial Studies (ICIS) of the United Nations Industrial Development Organization (UNIDO), with headquarters in Vienna, Austria.

casts, doubt concerning the methods used, and fluidity in the strategies of the nations concerned. Changes in the structure of the iron and steel industry affect various groups of countries in different ways. The industry is one where national governments are heavily involved, either directly or indirectly, not only in the centrally-planned-economy countries but also in the developing and market-economy countries.

The world's output of steel has been depressed since 1974. The annual production figures in millions of metric tons were: 1974-708; 1975-646; 1976-676; 1977-674. [In 1978 the world total returned to 712, with world capacity at 810-820; Western Europe and Japan were operating well below their capacity.] After more than 40 months the traditional explanation of lowered output as reflecting the "steel cycle" loses validity; structural transformations seem to be taking place. In this context it is necessary to examine the medium and long-term projections for demand and production of steel, and note how they have recently been shifted downward.

Medium and Long-Term Projections

The study of the world iron and steel industry carried out in 1976 by the ICIS contains forecasts for the world demand and production of steel for 1985 and for the year 2000 (Table 1). These forecasts were based on a continuation of earlier trends, with some slowing down of growth in the developed countries balanced by strong sustained growth in the developing countries.

Table 1: ICIS Forecasts in 1976

	Millions of metric tons		Annual growth rates (%)	
	1985	2000	1975-85	1985-2000
Consumption	1,069	1,665-1,925		
Developing Countries	170	395-655	7.8	5.8-9.4
Developed Countries	899	1270	3.0	2.0
Production	1,069	1,665-1,925		
Developing Countries	125	378-487	12.0	7.7-9.4
Developed Countries	944	1,287-1,438	2.8	1.5-2.6

Since the beginning of the fifties the iron and steel world had become accustomed to a steady average rate of growth in the consumption and production of steel: nearly 5% per year between 1955 and 1974, 6.2% from 1960 to 1965, 5.3% from 1966 to 1970. The steel economic cycles, covering periods of about 40 months, showed variations oscillating around this sustained trend. The Conference of the

International Iron and Steel Institute (IISI) held in October 1974 showed the confidence of those in the iron and steel industry in a continuation of this growth: it forecast that the year 1975 would show an increase in annual production of 4.2%. The 9% fall in the world production of steel in 1975 was thus completely unexpected.

Nevertheless, expectations of steady and sustained growth were so profoundly ingrained that the estimates and forecasts made in 1976 by a variety of national experts for the period 1980-1985 ranged from only moderate pessimism to marked optimism. This prolonged optimism was partly based on the announcement of an extensive "redeployment" of the iron and steel industry towards areas better provided with energy, minerals and capital, and away from those northern European or Japanese sites which were threatened by high levels of pollution. The survey carried out in 1976 by the EEC on investments in the coal and steel industries indicated that "the unfavorable economic situation in 1975 has not prevented companies, with a few exceptions, from carrying out the investment programs which were in hand or already decided on."

The prolongation of the recession in the iron and steel industry in many countries into 1977 caused a modification of these views, as was shown at the annual IISI Conference held at Rome in October 1977. The Secretary General's report noted that the various indicators which were available gave little comfort and that, while the recession had principally affected the market-economy developed countries, the developing countries--particularly Latin America--were not unaffected. He concluded that: "The present period of lower demand for steel has brought in its wake increased competition on the international level, lower prices, and what is generally described as the steel crisis." Whereas the Eighth Annual Conference in 1974 had estimated the net new capacities to be installed between 1974 and 1985 in the market-economy and developing countries as 240 million tons of crude steel, these forecasts were reduced "after a very careful examination of all the projects" to 142 million tons, divided up as shown in Table 2. These estimates were not exaggeratedly pessimistic; the information available during 1978 has seemed to indicate they were realistic.

The "crisis" has today become the central subject of commentaries and analyses relating to the development of the world iron and steel industry. Many of these have a tendency to enlarge on the dramatic character of the phenomenon. The iron and steel industry in the centrally-planned-economy countries, however, continues to expand, and this applies also to the developing countries. Thus, a condition of widespread and relatively steady growth has given place to national or continental changes which are diverse, and sometimes abrupt. This development has provoked considerable unease, the more so since the causes of these abrupt changes are still obscure, and the statistical or other tools available at present do not make it possible to answer the new questions which are posed.

Table 2

Estimates by the International Iron and Steel Institute of the Additional Iron and Steel Capacities to be Installed Between 1974 and 1985
(million tons)

	1974 Estimates	1977 Estimates	% Reduction	Capacity Installed '74-'77	Capacity to be Installed '78-'85
ECC	41.3	23.6	43	14.5	9.1
Other Western European Countries	26.7	14.1	47	9.2	4.9
North America	28.5	13.0	54	3.9	9.1
Latin America	37.2	30.7	18	13.3	17.4
Africa	12.3	5.4	56	3.8	1.6
Middle East	23.8	9.5	60	2.8	6.7
Far East*	67.9	43.9	35	17.0	26.9
Oceania	2.3	1.8	22	-	1.8
TOTAL	240.0	142.0	41	64.5	77.5

*China and North Korea are not included.

Forecasting Methodology

The difficulties in forecasting are not specific to the iron and steel industry; other sectors are in the same position. The difficulties are accentuated when sectors are particularly sensitive to macro-economic variables; forecasting their long-term development seems highly uncertain today. Sectoral expertise is now being disarmed by external uncertainties; technological forecasting is therefore affected. In the case of the iron and steel industry, the IISI has started revising its projection activities from the ground up by analyzing all the available data on developments over the last four years to identify, by successive tests, those correlations (and, as a consequence, the methodological approach routes) which are significant.

For example, the critical analysis carried out by the IISI on its own research methods has drawn attention to the low degree of correlation between the per capita national product and the level of steel consumption (steel intensity factor) in the developing

countries. The countries studied were the Republic of Korea, Mexico, Brazil, Iran and the Philippines. The study of these examples suggests, by contrast, the importance of that part of the national product which is allocated to fixed capital formation as related to the development of steel consumption; this high correlation was also confirmed in the case of Colombia and Tunisia. This is leading to more intense study of steel consumption in particular sectors. Some of the problems involved are: a) predicting the future substitutability of steel and other metals, materials or plastics in different uses; b) the effects of future energy costs on the life cycles of durable goods (e.g. automobiles, electric appliances).

Another method used by several developing countries to project the demand for steel is to assume that the national consumption of steel at this or that date can be approximately evaluated from the consumption of steel in another reference country 10 or 15 years previously. The value and efficiency of such a method of temporal relationships depends upon how well-based are the analogies between economies situated at different stages of development. This leads into the problems which are linked to the steel intensity curve, that is to say the hypothesis of a national pattern in the quantity of steel consumed per capita that increases and passes through certain predictable stages before reaching a culminating point, approximately defined in the work of the IISI by the steel consumption of the United States (approximately 500-550 kg per capita).

The determination and employment of this culminating point poses several questions: a) If per capita steel consumption has already arrived at or is close to its "maximum" level, is no significant increase probable up to the year 2000? Under such conditions is it probable that the consumption of steel in Europe and Japan will fall short of the American consumption? What will be the consumption of the developing countries: will it pass through the various stages of a curve at the same rate, or with a time delay, or will it involve a different rate and structure? b) Will the curve of growth in per capita steel consumption in the USSR flatten out, or will it continue to rise up to the year 2000, well beyond 600 kg per capita per year, under the influence of the high priority given to heavy industry and infrastructures? c) What is the real significance of the "summit" of the steel intensity curve reached today in the United States? Does a descending phase automatically follow this culminating point? No country yet has experience of an economy which has arrived at this stage. These questions significantly enlarge the field of investigation to find methods suitable for grasping the development of the demand for steel and of the world iron and steel industry.

Outlook for the Developing Countries

Despite uncertainties, some convergence of opinion can be seen on the 1985 prospects. The world demand for steel in 1985 will probably be less than 1,000 million tons but at least 960 million. [Other recent estimates center around 900-950.] Steel production in the developing countries in 1985 is likely to be less than 150 million tons, since the projects which are capable of entering into production by that date represent a new capacity of less than 55 million tons--excluding China. [Note: 150 million was the figure used earlier by UNIDO; current forecasts center in the 100-125 million range.] Among developing countries, China is in a class by itself with its production of 30 million tons in 1977, the size of its coal and iron ore resources, and its capability for making its own steel manufacturing equipment. In 1978 its plan was to reach 60 million tons capacity by 1985. [In 1979 this was revised down to 45 million tons.]

A large number of the iron and steel plants installed in the developing countries are limited to the production of "long" products and, in particular, to the production of concrete reinforcing rods, along with wire rods and small merchant products. Multi-product installations which produce long products (concrete reinforcing rods, merchant goods up to large beams and rails) as well as "flat" products (hot and cold-rolled sheets, subsequently tinned or galvanized) exist in only a limited number of developing countries. The number of producers of alloy steels amongst the developing countries is even smaller.

The weakness in the production of flat products and also of alloy steels indicates an iron and steel industry limited to paths which can be described as "secondary." The production of machinery and durable consumer goods necessitates both: flat products--thick plate for heavy equipment, thin sheet for durable consumer goods (automobiles, domestic electrical appliances); and alloy steels, whether special steel sheets for the chemical industry, or various parts for the manufacture of motors, turbines, alternators, etc. The developing countries at the present time remain largely outside these circuits, restricted to the production of long products used by the building and public works industries or the production of semi-products for local finishing. This raises the question of the criteria for access to production potential, and the constraints on the development of new activities in this industry.

The national availability or non-availability of iron ore and coal resources are important factors, but not decisive constraints. Recently some countries lacking these resources have shown the most rapid rates of expansion: the industries in Japan and the Republic

of Korea, and the non-integrated or semi-integrated steel industry in the Brescia region of Italy are the most striking but not the only cases.

The criteria of dimensions concern the size of the population and the market. Aside from Qatar and Abu Dhabi, which are in an exceptional situation as oil producers, no country with less than a million inhabitants has constructed an iron and steel project. No developing country with less than 10 million inhabitants (except Chile) possess or has constructed a capacity for the production of flat products. All this must be taken into account. However, it is less certain that a finding at any given moment from the state of techniques and markets can be erected into a rigid principle. Does, for example, a capacity of 1 million tons constitute a minimum threshold for constructiing a production unit for long products in a country of 8 million inhabitants with a per capita consumption of 130 kg? This is not so certain when techniques are evolving, and where factors of production are capable of combining differently in the future (see discussion below).

The development of iron and steel industries in the developing countries has resulted in some additional exports to world markets, but their volume will probably be limited for some years to come. It is true that the iron and steel industry in the Republic of Korea has systematically and efficiently launched itself into major exporting activities; but this is not true in the same degree for the other and most advanced iron and steel industries in the developing countries. India, Brazil, Venezuela, Mexico and Argentina have, to be sure, announced that their iron and steel industries would become exporters, and in some cases major exporters, in the long, medium or even short term. In fact India and Brazil have begun to export from 500,000 to 1 million tons per year; but the quantities exported are not likely to increase rapidly in the coming years. Development prospects of the iron and steel industries have been or are being revised. It seems that everywhere, even if more moderate exporting objectives remain, a greater priority will always be given to satisfying the rapidly increasing demands for domestic consumption.

A few developing countries have acquired the ability to produce their own equipment for iron and steel mills. Brazilian industry is capable of supplying 70 to 80% of the equipment necessary for building a large integrated iron and steel unit; China has already supplied the equipment necessary for building an iron and steel unit in Albania; India is also very advanced in this field; Mexico and Argentina are capable of making many parts of the iron and steel equipment.

Recently a large number of export-oriented iron and steel projects in developing countries that were linked to the process of "redeployment" or relocation to new areas (mentioned earlier), projects devised and financed by the major Japanese and European iron and steel companies, have been abandoned, and others have been scaled down. Mitchell Hutchins noted in May 1977 that, as compared to early 1976 when 49 "green field" site plants (i.e. plants in new non-urban areas including many in developing countries) were planned which would add some 33 million tons to world steel capacity by 1989, a year later this estimate was sharply reduced to 12 million tons. Of 44 plants under consideration, 31 had been "abandoned," 10 may be under construction by 1980, and 3 may be "on order." In 1978 the situation seemed to be worse. [Note: Such estimates, of course, can vary over time.] New European plants have also been affected; and world steel capacity for some years ahead has thus been set back. However, this trend provides an opportunity to accentuate the priority given to strategies favoring national or regional integration, which may have positive aspects. The revision of present strategies in many developing countries seems to be moving in this direction, toward the construction of more locally oriented facilities, although not to the complete exclusion of active participation in world trading.

Effects of Some Technological Developments

Iron ore. The developing countries (including China) own 30.4% of the world reserves of iron ore, but they have been supplying about half of the world exports, a share which will continue through the 1980s. The present growth of the so-called "waterside" units of very large size has, in fact, accentuated the pressure on exports of high quality African, Latin American and Asiatic ore--Also Australian and Canadian ores. In general the most interesting deposits, because of their content, purity, size or closeness to the coast, have already been worked. In coming years it will be necessary to satisfy both the demand for exports together with new national requirements from ores more costly to extract and/or transport. World reserves of iron ore are abundant, so that theoretically no long-term supply problems are present. However, the opening of new mines has become a very expensive operation requiring the mobilization of very considerable amounts of capital. At the present time it seems that many important mining projects, although recognized as economically valid, are being held up for lack of external financing.

Recent developments in the iron and steel industry have favored the production of high quality ores to be used in large blast furnaces. The development of direct reduction will also operate for some time in favor of very pure and high quality ores. Such developments tend to make ores of lower quality and lower purity of less value. However, several experiments in the construction of iron and steel industries--particularly in China--demonstrate the possibility of using in an economic manner ores which are neither of high quality nor very pure.

Reducing agents. Coke is the traditional reducing agent used in the iron and steel industry. This is obtained from coking coal, 94.8% of the deposits of which are in the developed countries. With respect to non-coking or low-grade coals, the developing zone has 14.6% of the world reserves, and China and India have practically all these reserves. Wood charcoal was for several centuries the only reducing agent used in the production of cast iron and iron; its use is now exceptional, Brazil being one of the rare countries to operate modern blast furnaces on charcoal. The use of charcoal cannot be greatly increased since about 30,000 hectares of forest are necessary to supply a very small blast furnace of 100,000 tons per year.

The developing countries, on the other hand, are much better provided with natural gas (45.8% of the world resources), petroleum (79.0%), and hydroelectric power (62.7% of the world potential). The distribution of these resources favors the Middle East and Africa (North Africa for gas and petroleum, Central, East and West Africa for hydroelectric power), regions which are poorly endowed with coal (coking or otherwise) and forests. These realities demonstrate the interest for many regions which lack coal resources, and have therefore remained on the margin of the iron and steel industry, in the development of viable alternatives to coke.

Direct reduction processes. The direct reduction or pre-reduction processes are so named because they make it possible to achieve economies in costly installations by passing directly from iron ore to a product called sponge iron which is capable of being charged into an electric furnace to be converted into steel. These processes operate either with a solid reducing agent (low grade coal), or a reducer in gas form which then uses a stack furnace, a fixed bed, a fluidized bed, etc. There are a number of different processes available today, only a few of which have proved their profitability.

Research work on the direct reduction of iron ore resulted in the construction in Mexico in 1957 of the first direct reduction unit of 200 tons/day. The process, to which the company gave its name HYL, uses natural gas and produces, from a high grade ore, iron pellets which are then converted into steel in an electric furnace. This was a major innovation, making it possible to open up, alongside the classical blast furnace route, a new iron and steel route--the more so when direct reduction could be coupled with electric steelworks, and where the availability of natural gas could provide both the reducing agent and a cheap source of electrical energy.

In practice this innovation remained a strictly Mexican affair for a long while, and it was the object of very considerable caution in world iron and steel circles for a decade. By January 1977, however, total capacities of 8.8 million tons were in production in a number of countries, and capacities of 22.2 million tons "were the object of a contract with prospects of completion before the end of 1980." Up to 1977 the industrialized countries owned about 75% of the direct reduction installations, but 60% of those which were to enter into service from 1977 to 1980 are in developing countries. This proportion will be maintained for projects retained or studied up to 1985 and beyond. Mexico, Venezuela, Brazil, Iran, Iraq and Indonesia are the countries which have made a deliberate (though not exclusive) choice of direct reduction.

In the industrialized countries direct reduction units have recently been closed down, construction of new units has been held up, and various projects have been frozen because the price of scrap iron, the substitute for sponge iron, is still falling. As Metal Bulletin (September 27, 1977) put it, "with prices of scrap iron so low, iron and steel technicians have no encouragement to invest even the most modest sums in the production of sponge iron, even if it can be clearly seen that when the steel market improves the supply of scrap iron could shrink very rapidly." However, a Spanish iron and steel technician has states: "It is clear that there will be a shortage of scrap iron. It is clear that direct reduction is the solution...therefore we must start on this."

The "breakthrough" at the end of the sixties and early seventies gave priority to direct reduction processes based on gas, either natural gas or reforming gas, and most of the units

constructed or planned so far employ the two principal processes using gas (MIDREX and HYL). The immense reserves of natural gas in the OPEC countries have opened up very large prospects to these processes. However, attention should be drawn to the advanced tests carried out in the United States on the direct reduction of iron ore using low grade (lignite) coal. Much research work is currently being carried out to promote processes with a solid reducing agent, or to make possible the use of several types of solid or gaseous reducing agents. This opens up a possibility for regions which have large resources of low grade (lignite) coal, that is to say the US, USSR, and Germany but also Brazil, the Balkans (Bulgaria, Yugoslavia, Greece), India, Australia and probably China.

The major potentialities which the direct reduction process opens up are only now beginning to be appreciated. Sponge iron is a high-quality product which can be used not only for the production of ordinary steels but also for fine and alloy steels. It has been proved in Mexico, as in the Argentine, that sponge iron is an excellent material for the production of special steels. In addition, very optimistic evaluations have been made concerning the cost advantages presented by direct reduction processes as compared with the classical blast-furnace processes. In the case of the Venezuelan SIDOR installations the investment, including continuous casting but excluding the rolling mills, was 40% lower than the investment which the classical route would have necessitated; and this resulted, in operating costs, in a 20% gain in the cost of producing slabs. These evaluations, however, must be treated with a certain amount of reserve while awaiting their verification when the installations are completed and put into service.

It would seem that the direct reduction processes are characterized by flexibility as compared to blast furnaces. Concerning the ores which can be used: up to now there has been an insistence on the high iron content required, but recent developments are tending to enlarge the range of ores which can be used in the direction, for example, of sulphur-containing ores. This aspect is the subject of active experimental work. From the point of view of the reducing agents, certain of the processes previously developed for the use of low grade coals can accomodate themselves to fuel oil, natural gas or coking gas.

From the point of view of size: the normal size of direct reduction installations is in the region of 300,000 - 600,000 tons per year, depending on the particular process selected. Several of the processes make it possible to envisage not only much smaller sizes, down to 20,000 tons per year in the case of the

Italo-Swiss Kinglor-Metor process, but also much larger sizes, since the possibility is now being studied of producing units of 1,000,000 tons per year. At all events, since the number of direct reduction units can be multiplied in one site, there is nothing to prevent the construction of integrated iron and steel units of several millions of tons annual capacity using this process. It is this which is now being done in Venezuela with the extension of the SIDOR unit at Matanzas. At the same time the complementarity of direct reduction units with large classical steelmaking units has been shown to be extremely profitable, since small direct reduction units are able to use and valorize steelmaking dust in producing sponge iron. From the very smallest size to the largest size the direct reduction processes enlarge the range of possibilities for access to the iron and steel industry. This is of great interest for all concerned, in particular in the developing countries.

If direct reduction is to become effectively and universally accessible, however, it is necessary that these processes can operate within a wide variety of contexts. This assumes that the following problems are solved: 1) So far, only those processes using gas have demonstrated that they can be profitable, although other possibilities are known--as mentioned earlier. Thus, a major problem is the development of cost-effective processes using using other energy sources. 2) Size and modules: The advance of solutions is rapid, both in respect of installations of very small size (20,000 t/year) and those of very large size with unit modules of 1,000,000 t/year. 3) The ores which must be used: Development of the use of local ores, and not only high purity ores, constitutes one of the requirements for a more rapid utilization of direct reduction. This problem is not given the highest priority amongst those who have the research capabilities. All the leading processes are controlled and offered by companies of the market-economy developed countries. Any discussion on technical cooperation in the iron and steel sector should consider the progress of direct reduction processes in the developing countries, including R&D to make it possible to speed up the adaptation of the processes to a variety of contexts.

Size and Scale Economies

Many of the developing countries are small: more than 50 of them have less than 1 million inhabitants. Industrialization of these countries must confront the general trends towards economies of scale. Today scale economies affect most of the sectors of the economy--large freight aircraft and bulk ore carriers, and supermarkets; but scale economies are most strongly experienced in

industry. Physical phenomena linked to increases in the size of equipment and instruments improve performance, so that an industrial unit of large size costs less per ton of output than a smaller installation. During recent decades systematic research into scale economies has been accelerated and has become accepted as a world standard: the standard of "scaling up." A large proportion of the new equipment introduced has consisted in scaling-up innovations; this has been especially true in Japan and in the USSR.

Up to the middle of the nineteenth century the iron and steel industry was characterized by units of small size which used local resources of iron ore and wood charcoal, and which supplied local markets. The replacement of charcoal by coking coal did not initially bring much increase in the size of blast furnaces. The first moves towards larger dimensions took place from 1860 onwards when the increasing requirements for rails for railway construction in Europe encouraged the development of steel produced in large quantities by the Bessemer process, rapidly followed by the Siemens-Martin process and by the Thomas process. Until the twentieth century, 100,000 to 200,000 tons of annual capacity was an average size for integrated units. The second move forward was started in the United States under the pressure of a massive consumption of sheet intended for the automobile industry, for domestic electrical appliances, for packagings and also for transport and oil refining. The first hot rolling mill for wide strips dates from 1926; its capacity was 600,000 tons. Fifty years later, integrated units for the production of flat units have capacities ranging from 3 million to 10 million tons; the size of steelworks and blast furnaces has shifted upwards until the Japanese built giant blast furnaces with a capacity of 5 million tons of pig iron a year.

Recent data on capital costs per ton of capacity indicate that the scale economies obtained in building the blast furnace, and the classical route (blast furnace + oxygen steelmaking), are very considerable. By contrast, the scale economies are considerably less substantial in the direct reduction/electric furnace route. To obtain capacities of more than 400,000 tons per year, it has until recently been necessary to juxtapose several direct reduction modules and several electric furnaces. However, scale economies tend to be found in all the routes of iron and steel production when larger enterprises can obtain systematic gains in the cost of capital and, as a consequence, gains in operating costs. This "law" of increasing returns to scale makes it difficult for developing countries of small or medium size to establish an iron and steel industry.

But now the universal value of the concept of scale economies is beginning to be questioned. Experience which is accumulating in developing countries indicates that this law operates less uniformly

than had been assumed. Furthermore, the continuing steel crisis exposes vulnerabilities in what had been considered very solidly based enterprises in the industrialized countries. Scale economies bore their fruit during the long period of growth, at the time when industrial installations operated at high utilization levels of over 90% of their capacity. The crisis has made these levels fall over extended periods to below 80%, sometimes to below 60% in certain European industries. The damage caused by operating this much below capacity is the more noticeable when very large units are involved. "The crisis has shown, amongst other matters, ...the greater adaptability of the so-called mini-mills..." (Metal Bulletin, May 9, 1978). Other disadvantages linked to large size are not related to the crisis, in particular the longer construction period before entering into operation, and the longer subsequent time for raising production up to the normal running rate in very large iron and steel units. This extension of the time necessary arises from the difficulty of mastering a complex assembly of very large size, where the continuity of the process implies precise articulation between the various sections, together with efficient adjustment to the environment. As the scale of sizes rises, so the "teething problems" are extended over two, three or even four years.

These phenomena are amplified in developing countries. The time necessary for building an iron and steel unit in a developing country is now much longer than the normally accepted standard in the developed countries. Recent examples indicate that an integrated iron and steel unit of 2.5 million tons was constructed in 36 months in an EEC country, and an iron and steel unit of 1.0 million tons was built in the same time in Eastern Asia; whereas it took 80 months to build a unit for 0.5 million tons in Africa and the Middle East. Such delays are very expensive: it can in fact be calculated that each month of delay increases the initially forecast investment by 1.2 to 1.4 percent. Entry into production also takes much longer in the developing countries. Aside from supply bottlenecks and other coordination problems, the mobilization and adjustment of a large work force is more difficult in a non-industrial environment. The developing countries have experienced so many obstacles in the training of personnel--irrespective of where the training took place--that it has encouraged them to rethink the problem of training as a function of the size of the production unit, and of other parameters not taken sufficiently into consideration, in particular the links between the technological processes and the form of individual and team work.

The available information on the developments which are taking place in both types of countries tends to call in question the universality of the law of scale economies. Recently, it has been noted that an iron and steel production unit consists not only of surface areas and volumes but also of a group of workers required to master

technical processes which are increasingly continuous on the basis of complex machine systems. Such a mastery can only be progressive; it implies stages--social laws and not simply physical constants. This context needs to be better perceived, better evaluated and analyzed to arrive at the definition of thresholds from which scale economies can effectively operate. The move towards "scaling-up", considered for a long while as irreversible, developed in the most advanced industrialized economies, USA, USSR, Japan, Germany, etc. which are or have been economies of world scale. Today the crisis phenomenon, together with the desire for industrialization of numerous smaller developing countries present new problems: not only those of scaling-up but also those of scaling-down, of new approaches to what might be termed "miniaturization."

In order to advance along this route consideration must be given to numerous concrete experiences which fall outside the normal. The "mini-mills", or small-size iron and steel units, have multiplied over the last fifteen years in Italy, where the companies in the Brescia regions have been given much publicity; but this also occurred in the United States, in Spain, in Great Britain and in Japan. These are iron and steel units with unit capacities of 50,000 to 150,000 tons per year: non-integrated simple rolling units, semi-integrated units using UHP electric furnaces operating from scrap iron, and integrated units using the direct reduction/electric furnace route. These units specialize in the production of concrete reinforcing rods and also merchant products.

The problem of small size, which seems to be solved in the case of concrete reinforcing rod and small merchant goods, continues to be posed in the field of heavy sections and rails, but particularly in the field of flat products, in the production of slabs, hot-rolled sheet and heavy plates. The size of the mini-mills would therefore be inadequate to integrate modern rolling mills producing flat products. However, it is important not to ignore the possibilities which do exist regarding certain products in this category. Some authorities feel that "by accepting a product of slightly lower quality, it is possible to produce flat products in small size units using mills of the Steckel or Senzimir type. At the present time this is exceptional, but technical developments are possible in this field." (A. Van der Rijst and H.H.J.M. Derkx) For example, a new unit recently installed in Great Britain with a capacity of 250,000 tons is competitive in its hot rolling mill, which produces flat products, with the production of a major integrated iron and steel unit nearby. Initially the quality of these products may not be as good, but the highest quality is not required for all uses of flat products. It would be advantageous to identify, in the developing countries interested, what proportion of the possible uses are con-

sistent with the quality obtained from medium-sized flat product rolling mills. This proportion would probably not be negligible.

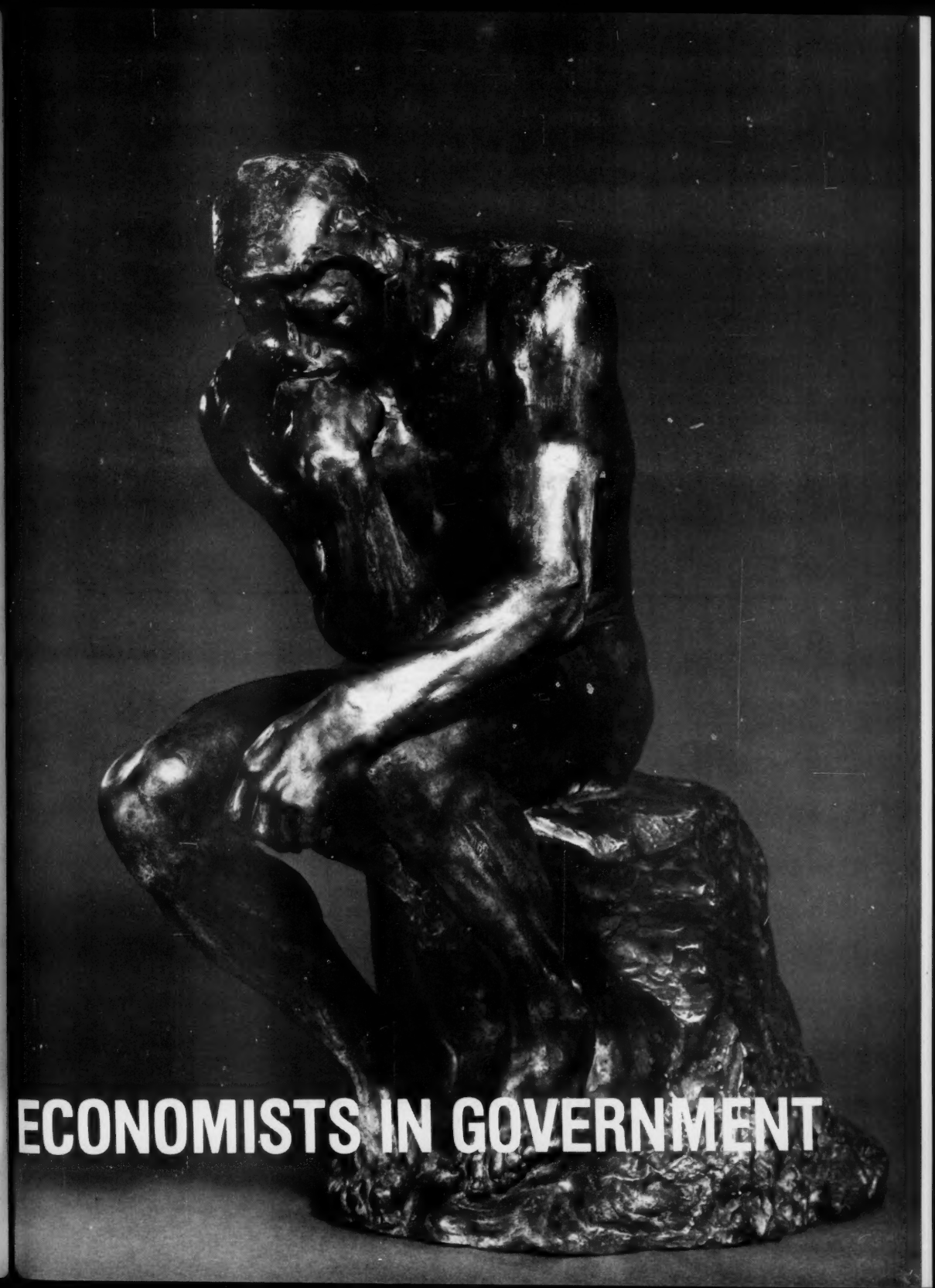
If production of "the bottom of the range" of products were to move from the larger installations to the profit of the smaller and medium and hence less expensive installations, this runs the risk of depriving the larger installations of the mass production, of the income essential for their profitability--that is to say for the operation of scale economies. The stakes are therefore high. These potential "portents of the future" are important for developing countries which wish to master the various ranges of iron and steel production. This is why the analysis of concrete experiences in medium-sized iron and steel units should be carefully undertaken: in Yugoslavia, Bulgaria, Egypt, Chile, Algeria and New Zealand, and anwhere medium-sized units integrate the production of flat products or medium and heavy sections. It is of value to compare these realities, diverse as possible, with what has been put forward as the imperative of scale economies.

[Another important factor not described here is the sharp increase in mill and mine construction costs, which aggravates the problems of obtaining financing for projects in developing countries. This too may contribute to a move toward a scaling-down in size of steel installations in these countries.]

In conclusion, it appears that the future directions of development in the iron and steel industry are much less clear and predictable than they appeared previously. But this is not necessarily bad news for the developing countries. The availability of finance is probably lower than before, to be sure, but the technical evolution in the industry seems to be opening new opportunities. Perhaps all that can be foreseen is diversity: different countries are likely to move in a greater variety of directions than was possible heretofore, and with a more strongly local orientation.

[Adapted from The World Iron and Steel Industry (second study), published by the United Nations Industrial Development Organization, November 1978. United Nations document No.: UNIDO/ICIS.89.]

Note: Inserts in brackets providing updating were largely based on William T. Hogan's article in Center Lines, Vol. XIV, May 1979.


ECONOMISTS IN GOVERNMENT

SCULPTURE OF "THE THINKER" BY AUGUSTE RODIN SYMBOLIZES THE PRESENCE OF INTELLECTUALS IN GOVERNMENT. (PHOTO: COURTESY OF THE NATIONAL GALLERY OF ART, WASHINGTON, D.C.)

Economists in Government: The Case of Malawi

B. D. Giles

[The way in which economists are successfully integrated into the machinery of government in Malawi is described and briefly compared with Zambia. The author has served as an economist in several African governments.]

Most of the functions of an economist working for the government of a small African country, and perhaps other countries as well, can be classified under three very broad headings: analysis, information and communication.

(1) Analysis - selecting, and if need be, adapting the analytical tools relevant to each job as it comes along. Nobody needs theory more than the practical man; the choice of which model or models to use as the basis for advice is one of the more important decisions that has to be made.

(2) Information - The economist is the recipient of information, some qualitative--both verbal and written--and some quantitative, from accounts of government and business, consultants' reports and above all official statistics. He may be able to make a marked contribution to the quality of this last class of information by trying to ensure that the data collected are significant for his purposes. For example, he can check the questionnaire used in a census of production to see that the definitions are such that the material can be used for compiling national accounts. In a census of population he can press for questions that will provide frequency distributions by age, education and occupation, even if it means ex-

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cluding some questions of interest to religious and political bodies. In doing this he must take a long-term view; often he must try to anticipate what he or his successors will want to know ten or more years later, and persuade the statistical office to collect and process it.

(3) Communication - feeding the results of economic analysis into the decision-making machinery of government in such a way that the economist's view is taken into account. Although rarely discussed at length in the economic literature on development, this feature of the job is at least as important as the other two. The finest analysis based on the very best information will be sterile if it is not even considered by those responsible for taking decisions. This is the problem that will be discussed in detail in this paper, on the basis of personal experience in Malawi and to a lesser extent in Zambia, Lesotho and Swaziland.

Economic advisers and planners, however competent, suffer from two main handicaps, namely an almost total lack of understanding of their function by laymen, and the risk of complete uselessness if cooperation from other professionals is not forthcoming. Whereas it is reasonable to assume that an educated layman has some idea of what to expect from civil engineers, veterinary surgeons, agronomists and doctors, it is almost, if not quite impossible to explain to a non-professional what an economist can and cannot do. When I arrived in Lesotho in 1965 as the first professional economist in that country's government, I was variously regarded as some kind of accountant, an expert in setting up factories in mountains, or the holder of a key to the vaults of some of the world's larger financial institutions. It was not until I became involved with customs negotiations with South Africa, and was able to demonstrate in one field that economic analysis can throw light on important problems, that there was any understanding of why an economist should be employed at all (apart, of course, from the need to present a facade of respectability to the World Bank and other aid agencies). In Swaziland in 1969 I felt constrained to leave a paper behind explaining what the economic planning office could do; and in Zambia in 1975 I was left with no doubt that the government neither knew nor cared what the twenty-five economists in the Ministry of Development Planning got up to so long as they produced a volume for public consumption to be called the Third National Development Plan. My experience may well be fairly typical. Ministers and civil servants normally determine the allocation of resources without taking much account of economic advice, and the economist is confined to doing a cosmetic job on programs approved elsewhere in government and acting as junior advocate before financial agencies when the government seeks external funds. It is reasonable to suppose that economists are often bypassed because nobody knows what they can be asked to do.

And, of course, economists can do nothing of immediate use on their own. They can speculate about consumption functions and the like in the abstract, but that is usually as far as they can go. They cannot, for example, design a road or supervise its construction; but, given some cost estimates, data on permissible axle loadings, traffic censuses and vehicle running costs, they can make an investment appraisal which may influence decisions on which roads to build. In general the contribution to development that economists can make is much more dependent upon cooperation with laymen than is the case with most other professions. After all, most of the world's development to date has occurred with little assistance from economic analysis, and Keynesian 'animal spirits' still determine more investment decisions than does discounted cash flow.

These two factors--ignorance of the subject and the helplessness of the economist in isolation--are probably sufficient to explain why economists are usually ignored. That they sometimes say things that the people in power do not want to hear only makes things worse.

What in fact can an economist do for a government? Perhaps the most comprehensive answer is that he may be able to improve the quality of the decisions taken in some areas. Economic planning offices do not determine economic policy, and their powers are often grossly over-rated by implication in the theoretical literature on planning and by visitors--except for those more experienced staff members of aid agencies who know that a Secretary for Finance, or Agriculture usually carries far more weight than a Director of Economic Planning. At most, the economist in a planning office or elsewhere can set out the economic implications of any proposals, ask questions that may be awkward, and draw attention to inconsistencies and alternatives. Only if the economists are allowed to make these contributions can they demonstrate their worth.

It might be thought self-evident that economists employed by governments would automatically be accorded a hearing. Not so. They are all too easily frozen out by executive ministries or simply ignored. Donor countries and international agencies, in their technical assistance programs, press economists on poor countries and offer generous post-graduate training to local economists, but the recipient government rarely feels greatly in need of them. This is shown by the alacrity with which the ablest economists in government service are transferred to administrative and diplomatic posts--it does not happen to anything like the same extent with engineers or doctors or lawyers.

These problems cannot be resolved overnight. If they are to be overcome they require that economists be integrated into the day-to-

day machinery of government so that there is a regular 'drip-drip-drip' of economic commentary into the counsels of the nation at all levels. More economic rationality is likely to find its way into the making and execution of policy by treating economists on a par with other professional advisers than by setting them to make comprehensive plans which can be comprehensively ignored and which, given the shaky nature of their factual and theoretical foundations, deserve to be ignored. Thus, the issue is not one of the role of economists in general, but also one of the relative weight of comprehensive planning versus more numerous, but smaller-scale, interventions in the specific conditions of poor and small countries.

In short, consultation with economists has to be an established routine if they are to have any significant influence. Establishing such a routine where it does not exist is the principal reason for putting the economic planning service into the portfolio of a politically powerful minister who can discipline departments that ignore their economists. One would not aim at giving economists a god-like status--there is more to economic development than economics. One merely wishes to ensure that the economic analysis, such as it is, gets taken into account when decisions are made.

The precise form of organization is perhaps a matter of choice, but reasonably successful systems are so rarely found in operation that it is worth describing one that does work fairly well and, in my experience and in the experience of visiting officials from various aid agencies, is probably the most effective system in ex-British Black Africa, namely in Malawi. Not all the analysis that was done was actually fed into policy-making. Nevertheless, quite a lot did get through, and on the whole the economists probably made a worthwhile and effective contribution.

The Position of Economists in Malawi

The Economic Planning Division. The system was based upon an Economic Common Service headed by a Chief Economist, who was also in charge of the Economic Planning Division (EPD) in the Office of the President and Cabinet.

The Economic Planning Division received as a matter of course copies of every project document and consultants' report emanating from ministries or state enterprises (parastatal organizations). It was represented on most committees and boards dealing with economic policy, and it was responsible for preparing, in consultation with the National Statistical Office, the Reserve Bank of Malawi and the Ministry of Finance, preliminary estimates and short-term forecasts of the national accounts and balance of payments. It also made special studies, often by request, such as projecting the demand

for sugar or cement, or investigating the merits of three possible locations for a rice mill. It had neither the staff, nor the experience, nor the funds to undertake project appraisals itself, but its comments on the work of consultants and others were always regarded as an important contribution to particular debates. The two areas from which it was almost completely excluded--and probably rightly so, given its lack of expertise--were budgetary policy, which was decided under the usual shroud of secrecy by the Ministry of Finance, and monetary policy which was determined mainly by the Reserve Bank. There was quite close contact between EPD, the Bank and Treasury on most matters, but the most important issues were not always discussed with EPD.

The close integration of EPD with the policy-making machinery of other ministries inevitably meant there were considerable quantities of paper to deal with--something of the order of twenty pieces of mail per day. Some of it was routine (Government Gazette, official statistics, journals, etc.), but much of it involved work for somebody (invitations to meetings, request for information and advice, multi-volumed consultants' reports for comment and the like.) Although the volume of work was small by world standards, the office would have been unable to make a useful contribution without a routine method of dealing with the material that came in and a clear allocation of responsibility among the professional officers.

Basically, the Division was organized into four sections, called for convenience (1) Agriculture, (2) Trade and Industry, (3) Transport, (4) Social Services. The staff establishment in each section was one Senior Economist and two Economists. One Chief Economist was in charge of the Division, assisted by his deputy, a Principal Economist. The 14-man Division was never at much more than half strength in my time, and I suspect that with really well trained officers the establishment would have been excessive for the work load.

Macro-economic matters--money, banking, general fiscal policy, national accounts and balance of payments--were the responsibility of the Chief Economist and his deputy. The classification of responsibilities of the sections was exhaustive. Most jobs fell fairly obviously into one or another category; there was never any friction between sections, and there was consultation and cooperation when jobs overlapped. The existence of an establishment structure was of the first importance. Not only did it facilitate the allocation of day-to-day work, but it provided long-term staffing objectives: one knew which posts one was recruiting and training for. This fairly obvious point had not been grasped in Zambia, where years of ad hoc allocation of responsibilities had produced a very unbalanced structure of staff skills and interests.

The daily routine was simple. Incoming mail was opened and brought straight to the Chief Economist, who directed it with comments to the Senior Economist in charge of the appropriate section. It was then passed to the Principal Economist who added comments of his own, and then to the Registry, where the filing clerk put it on the appropriate file and delivered the file to the in-tray of the officer to whom the item had been directed. Every letter in government was headed with its subject to assist in getting it on the right file to the right officer. Paper passing is not an exciting subject, but there are undoubtedly offices where failure at this simple mechanical level precludes them from doing useful work.

A great merit of the system was that two people in the Division had a fairly comprehensive if superficial knowledge of the whole range of government's economic activities, and they could draw on heads of sections for details as required. Also of importance in maintaining cohesion was the 'trip file', which contained a copy of every letter (except the most confidential) that was sent out. This was circulated once a week so that all officers had some idea of what their colleagues were doing.

One of the Division's most useful roles was that of an economic information center for other branches of government and overseas visitors. Indeed, through being a center of information EPD was able, without effort or rancor, to act as a coordinator. If, for example, on receiving a proposal from the Ministry of Agriculture somebody in EPD noticed that it was related to something being done by the Ministry of Transport, a suggestion that they should get together could earn the gratitude--and future cooperation--of both parties. EPD's position was certainly not that of a controller, but it was recognized as a lubricant of the government machine and was often able to exert influence because of the fund of goodwill and confidence that it had built up. In a very unsophisticated fashion it was also a source of economic intelligence, and its budget included an allocation of funds for newspapers, periodicals and books --not on the lavish scale of the Central Bank's provision, but enough for air mail copies of The Times, Economist and the Financial Times and perhaps a score of books a year. The point would hardly be worth mentioning were it not for the fact that the Ministry of Development Planning in Zambia took nothing apart from the local daily newspapers; and the budget for the UNDP team, of around a quarter of a million dollars a year, made no specific provision for books and periodicals--indeed there was a serious shortage of Zambia's own official statistical bulletin, because there was no money to buy it.

Although it was not formally set out, the notion of a minimum list of things to be done on every job was beginning to crystallize.

Like most check lists, once stated, it looks self-evident. The minimum list can be put in the form of four questions to be set against every proposal:

1. Is it in line with general government policy--e.g. on regional development, sectoral development, income distribution, protection, etc.?
2. Do the figures look reasonable?
3. Is the economic analysis plausible?
4. Is it related to any other actual or planned activity, and if so are any modifications required on either side?

As a rule the answers to all four questions were satisfactory, but there were occasions when a major flaw was noticed. For example, on one occasion, it was observed that draft of a rail project and a road project were both basing their estimates of cost and benefits on the same traffic.

Drafting comments and participating in meetings were the routine activity of EPD, but it also performed some more general functions. It had the good fortune not to be burdened with the preparation of a big set-piece plan document every five years. It had prepared a Statement of Development Policies in 1970, which consisted of a statement of general principles that closely resembled a fairly liberal textbook on economic development, followed by sectoral and macro-economic projections up to 1980. Nobody ever referred to the figures to see if the economy was 'on course'. In terms of GDP it was quite close to the projections, although many of the sector projections were wildly astray. The projections were being revised when I left.

The main purpose of these projections was to assist in project preparation and appraisal. Consultants, ministries, government corporations or private concerns were, for example, frequently interested in forecasting demand, and as a first (and sometimes only) approximation, a coefficient of income elasticity was applied to the projected growth rate of income. The EPD projections were probably based on more complete information than was available to anyone else, and they introduced an element of internal consistency into the whole development program. But it was becoming clear that, to be of use, the projections would have to be quite long-range and therefore uncertain. Their logical status was very vague: they were based on an implicit assumption that some level of investment would occur, but investment decisions were to some extent dependent on the projections. It is arguable that, in the development process, even bad decisions are preferable to no decisons; if so, the best contribution was to

speed up decision-making by putting a plausible set of projections on the shelf for reference. The absence of decisions produces uncertainty and stagnation or even deterioration, but the efforts to extricate a project from a bad decision can generate progress. A great strength of Malawi--as compared with some other governments--was that decisions were taken quickly, usually by the President. The availability of projections accelerated the preparation of projects to the point where they could be put before him for approval.

In so far as there was a plan it was a very unsophisticated one-year plan, the first year of a rolling three-year program which was presented with the budget in the Development Estimates each year. The second year's figures were rather shadowy and the third year's very tentative indeed. In fact, of course, as each year approached one found that most of the resources available were already committed to ongoing projects. Planners are never faced with a clean sheet. EPD, however, had had its say on every project, and could comment on the overall balance of each year's program.

The initiative for projects invariably came from ministries and parastatals, most of which had extensive but undated programs in outline in their files. For example, the Ministry of Works had a fairly comprehensive road network mapped out, the Ministry of Agriculture had crop and livestock schemes in outline, and the Ministry of Education knew what sort of schools it wanted and where. Each year they put up their requests for funds from the Development Budget to continue existing schemes or to embark on new ones, supported by a standard form of documentation setting out background information, objectives and probable expenditure over the next few years. Often the first that EPD would hear of a project would be when this material arrived in the mail. It would make such comments as it thought fit and the original proposals might be amended. Then, a few weeks before budget day, each ministry appeared before a committee drawn from the Treasury, the Development Division of the President's Office (which was keeping an eye on the Development Budget) and EPD. Final explanations were asked for, and at the end the Treasury and Development Division undertook the inevitable hasty cutting of estimates to fit available financial resources. In the world of theory, perhaps EPD should have been in at this final stage, arguing that the social benefit of a marginal K10,000 spent on A was greater than the same amount spent on B. In the real world, with budget day a fornight ahead and precious little information relevant to estimating marginal effects, EPD's guess could be no better than anyone else's, and it could only have looked foolish had it tried to interject esoteric considerations. With so much of the money from external sources tied to specific projects, there was not much room for maneuver anyway.

Each year the Division was responsible for preparing the Economic Report which was presented to Parliament as a budget document. The sectoral chapters were drafted in the appropriate ministry and revised by EPD in consultation with the ministry; EPD drafted the chapters on national accounts and balance of payments, and the Reserve Bank looked after money and banking. It was a severely factual document, of rather less than a hundred pages and about 80 tables, giving long runs of figures with preliminary estimates of some of the latest ones, and containing a sentence or so on the progress of every development project in the country. There was a minimum of cosmetic treatment, and then only on a few issues that might inflame the President with possibly dire consequences for someone. The figures were as reliable as they could be made. The first, and indeed almost the only aim of this exercise was to produce a compendium of factual and statistical material that would help administrators and professionals. It was widely used both inside and outside government as a first source of reference on national accounts, numbers of cattle slaughtered, retail prices, railway traffic, etc., etc. Indeed, there was a strong presumption that if an area of economic activity was not referred to in the Report, then no information was available. There were no comparisons with norms or targets, few excuses and little self-congratulation; it was about as dull and as useful as a telephone directory. A similar much smaller Mid-Year Review was produced around October giving forecasts of some figures for the current year.

These annual exercises served two very useful purposes. Firstly, they kept the Division fairly comprehensively informed about what was going on. In its capacity as editor of a parliamentary document it could obtain clarifications and explanations which might not have been forthcoming for an enquiry of its own. Secondly, the Report served as a frequent reminder of the usefulness and reliability of the Division, and earned it sufficient respect inside government for it to command a hearing on other matters. All this was in marked contrast to the comparable document in Zambia, which was much shorter, hastily prepared and contained little hard information.

Another function of the Division was to give general guidance in economic matters. For example, it circulated a fairly short set of guidelines on project appraisal. In effect, these were the U.K. Ministry of Overseas Development's condensation of Little and Mirrlees' handbook of project appraisal, further condensed and altered to suit local conditions. They helped to secure a certain amount of uniformity in the way projects were considered.

EPD also issued a short guide to business accounts in the private sector. It is a commonplace that even very good graduates in

economics from very good universities usually know little or nothing about the accounts of firms, although they may be well versed in sophisticated theories. It was not uncommon for professional economists to make glaring mistakes, such as confusing a profit margin with a rate of return. Although Malawi leans in the direction of laissez-faire, it is such a small economy that a number of firms are in a monopolistic position and therefore require some degree of scrutiny and control, notably over prices. Where multinationals were involved the relationship between their accounting practices and their local tax liabilities needed watching. Applications for industrial licenses and for protection from imports also had to be vetted. In all of these areas business accounts were a relevant part of the evidence. In a country desperately short of accountants, twenty pages of elementary guidance to officers in executive ministries dealing with private firms probably eliminated a lot of gross error. The demand for additional copies of the document suggested that it supplied a need, and it was a modest attempt to improve things in an important area. Officials acting in complete ignorance of elementary accounting principles could easily put a firm out of business, or allow it to exploit the public and the government, or bring government into contempt, none of which helps the development process.

It would be very impressive if one could say that EPD determined the minimum permissible rate of return that was acceptable in a project appraisal, raising it and lowering it to ensure that all investible funds found a suitable project. There was in fact a target rate of return, 12 percent, which was set several years earlier. It was still used as a reference point and projects that fell below it were very carefully scrutinized. There were, however, a number of very good economic reasons why it was not and could not be used as an automatic control over investment decisions. Some development theories are apt to conjure up visions of a library of fully worked out investment possibilities shelved in descending order of internal rate of return--50 percent... 20 percent...3 percent. The planner, it might seem, starting at the top, simply collects enough projects to absorb all the available funds, and he then has the investment program. In fact, project preparation is a slow and often costly business, and well prepared projects are scarce in poor countries. There are often funds available either interest-free or on IDA terms of 1 1/2 percent for a project that looks like yielding 7 percent, and there is no other way of absorbing the funds in sight. If one stuck to the 12 percent rule it would be necessary to spend months, perhaps years, putting together another project and negotiating finance for it. As a rule the sensible thing to do is to take the 7 percent option.

A further reason for treating the target rate of return rather lightly was that it was very rare for agricultural projects to show anything like 12 percent. Part of the problem lay in defining costs. Should the costs of additional tube wells in villages, housing, crop extraction roads and so on be counted as product costs? It was often difficult to say whether they would have been incurred anyway under government's general program of social services, or whether the project generated extra costs in these areas. No doubt some user charges could have been devised to take care of the problem in theory; in practice it was feared that any attempt to make a significant charge for ancillary services would so reduce the level of participation that the rate of return might fall even further. There were also problems of comparability--e.g. why include a direct charge for additional roads required for rural projects while urban roads were a general charge on the community? Furthermore, it was arguable that the rules should be relaxed because rural income appeared to be so low.

Thus the target rate of return was by no means the sole criterion applied to investment decisions; and public sector investments were so lumpy in relation to the size of the economy that it would have been ridiculous to insist upon it. Nevertheless, if the target rate had ever been adjusted, EPD would have led the debate on proposed changes. Similarly with shadow prices, had they ever been used: EPA would have initiated the discussion, made known the decision, and vetted every project to ensure that they had been employed in a uniform manner. Although in the abstract a cast-iron case can be made for shadow pricing, since markets are never perfect, there was no disposition to use them in Malawi. The overall balance-of-payments position was fairly comfortable, and there was not a very severe urban unemployment problem. Thus two subjects that appear to be crucial in development theory rarely crossed the minds of the economists--except in explaining the position to visitors. Internal rates of return and net present values were calculated for projects where the cash value was of primary concern, but there was not a strict cut-off point nor did it seem sensible to have one.

The Economic Common Service. The Economic Planning Division, together with most of the economists employed in other ministries, made up the Economic Common Service. Members of the Common Service were on the establishment and payroll of the ministries in which they worked. If they were to preserve their influence as professional economists, it was of the first importance that there never be any doubt about their loyalty to their own ministry. Apart from common professional interests, the most obvious unifying element in the Service was perhaps to be found in the functions of the Chief Economist who was responsible for recruitment, training and posting.

A ministry wishing to recruit an economist consulted the Chief Economist on the nature of the post, grading and qualifications needed, and whether local or (less and less frequently) overseas recruitment was appropriate. Local recruitment was mainly arranged by talking to each year's crop of university graduates and to a lesser extent by local advertisement. When the Public Service Commission interviewed candidates the Chief Economist or his representative was present. Overseas recruitment was arranged mainly through the Malawi Buying and Trading Agents in London. The Chief Economist assisted in drafting the advertisement, reviewed the written applications and reports of interviewing panels and made recommendations, which were usually followed.

Responsibility for training was mainly exercised by keeping an eye on the courses and fellowships available and nominating members of the Service where appropriate. The training ranged from attendance at a conference, through the specialized courses in project evaluation lasting a few months at Bradford University in the U.K., to Master's courses of up to two years' duration. The sources of funds varied, but Canada and the U.K. provided most of the money and UNDP was sometimes a donor of last resort. Normally local recruits were not sent abroad for training in their first year, but they were warned on entry that they might be required to train overseas--which was sometimes but not always an attraction. The intellectual quality of local recruits was relatively high, but they sometimes had difficulty in coping with overseas courses.

Posting members of the Common Service in the various Ministries presented quite delicate problems. There was a wide variation in the number and status of posts established in different ministries, and it would have been impossible to recruit good people for employment in ministries with only one or two junior posts unless transfers for promotion were permitted; one of the functions of the Common Service was to provide a ladder of advancement. Ministries, however, were naturally averse to losing experienced officers, and it was essential to assume that officers would only be moved for good reason, and to negotiate any movements very carefully. Basically the position of the Chief Economist vis-a-vis the ministries was very weak, because, as an extreme measure, a ministry could ask for a post to be abolished. The Ministry of Agriculture, which had ten posts for economists, was barely prepared to admit that they were in the Common Service until a circular from the Secretary to the President and Cabinet determined the matter. The Ministry of Education broke its link by changing the title of the economist's post. The Ministry of Transport also ceased to use the Common Service for a time, returning when they found that they needed some supporting economic expertise. In both cases the device used was

to create a post of 'planning officer' and transfer the economist to it with the inducement of a rather higher grading. The Chief Economist might appeal to the Head of the Civil Service, but it was not easy to ignore the views of the responsible head of a ministry on how he wanted to organize it.

Apart from providing a potential channel of promotion, the Common Service fostered a certain esprit de corps. Monthly meetings at which papers were read and problems discussed helped to foster a feeling of professional pride. Communication between members of the Service was almost certainly easier than would normally be the case between civil servants in different ministries. The economists played an unobtrusive part in explaining ministries to each other. In the early stages there was an element of suspicion that the Service was a kind of fifth column planted within ministries. This evaporated fairly quickly as it became clear that the economists were simply trying to do a professional job without intrigue; they were not pressing any policy of their own.

Recruitment and retention of good economists in government encountered some serious problems, which also arise in other African countries. Firstly, economists in their degree courses pick up some knowledge of the jargon, practices and objectives of commerce. They are therefore useful recruits for the private sector and parastatals, and these non-governmental employers can usually offer better pay and conditions than the civil service. Secondly, and for similar reasons, the Personnel Division looking for administrators--always desperately scarce--was liable to offer a good economist promotion to a general administrative post; in 1975, for example, the Principal Economist in EPD was promoted to Deputy Secretary in the Ministry of Trade and Industry (three levels higher), and lesser cases could be quoted. (In Zambia, where the copper mining corporations offer high salaries, the problem of retaining economists and statisticians was even more acute.) The limit of promotion for professional officers was "Superscale 5", and the Common Service only contained one such post, whereas for general administration there were numerous posts above that level. With the expansion of government and localization of posts, the excellent prospects for promotion probably attracted many of the better civil service recruits to "administrative" posts rather than professional cadres.

Comparison with Zambian System

The merits of the system in Malawi may be illuminated by a comparison with Zambia. In Zambia there was a Ministry of Development Planning (until December 1975 a Division of the Ministry of Finance). It contained about 25 economists, only four of them Zambian, all in

junior posts. Economists had been recruited on an ad hoc basis as needs were felt and, although the level of individual competence was high, far too many had specialized in the macro field. Papers for internal circulation in the ministry were produced in abundance, but there was minimal communication with the outside world. Almost the only function of the Ministry was to prepare the National Development Plan. There was no Economic Common Service. Individual economists employed in ministries were usefully occupied, but there was little professional contact between them and practically none with the so-called planners, so that there were none of the benefits which went with Malawi's network of non-planner professional economists spread across government.

In some ways the comparison with Malawi is unfair to Zambia, whose government has virtues not found in Malawi. The two countries have about the same population, 5 million, but differ in other respects, notably in the larger land area and mineral deposits of Zambia. In the early years of Zambian independence the planners in central government were undoubtedly influential. Those were the days when copper production was so profitable that its contribution to Zambia's budget and balance of payments probably exceeded the country's absorptive capacity. In 1967 the (expatriate) head of the planning office told me that their main problem was to find ways of spending all the money. By 1976, because of rising costs, falling prices and transport difficulties, the budget revenue from copper had disappeared and there was severe financial stringency. Within a few years scarcity became a real problem, and choices dictated by lack of resources had to be made. In those circumstances, ministers and officials with direct executive responsibility for projects and policies insisted that the choices be theirs, and the central planning office became superfluous. In Malawi, on the other hand, which had been poverty-stricken from the start, there was never any doubt that EPD was the handmaid of ministries which had the last word in making decisions, and it had adapted itself to that role.

There was also a difference in the degree of reliance on expatriate economists. In Zambia the more favorable employment opportunities for well educated people in the private sector, parastatals and general administration had practically denuded the government of Zambian economists and statisticians. So the staff of the planning office was almost entirely non-Zambian, none of them expecting to stay more than a few years. Malawi offered fewer alternative employments and, although a small number of people left the service, they mostly remained in the country. The usefulness of the expatriate economist is inevitably limited. He may have more technical expertise than his counterpart, but by the end of his contract he is unlikely to have acquired more than an anecdotal knowledge of the

political, religious, social and ethnic structure of the country, to say nothing of its language. For an engineer or a doctor this may not matter, but for an economist involved in policy-making it is of the first importance. In Malawi there were enough local professional colleagues to save an outsider from most indiscretions.

Despite the contrast in the status of the central economic agency in the two countries, the role and usefulness of economists employed in other ministries were very similar in both countries. Sometimes they generated useful work themselves, such as comparing costs of similar activities in different places and looking for explanations that would help to improve efficiency; sometimes they were assigned specific jobs, such as advising on an application for an industrial license or comparing probable costs and benefits of different road alignments; and very often they were taken into general policy discussions. They were fully used, often overworked, and their contributions were valued. Paradoxically, there was probably more de facto coordination of economic policy in Malawi, where central planning was derided, than in Zambia, where it was ostensibly an article of faith. Membership in the Economic Common Service in Malawi encouraged communication between economists in different ministries. Each knew a good deal about what the others were doing, and this provided a useful inter-ministerial link. Economists in Zambia exchanged views and information on a personal basis, but they tended to work more narrowly within their own ministries.

Results. Economists rarely attempt to apply cost-benefit analysis to their own services--perhaps from modesty, or perhaps from fear of the answer. In Malawi there was a constant flow of simple economic analysis and comment into the policy-making machinery, mainly but not exclusively in connection with the public sector development program, amounting to about $65 million in 1975/76. If the economists' contribution raised the rate of return by one-tenth of one percent on average, it would increase the yield of the 1975/76 program by $65,000 per year. Taking a 12 percent rate of discount and a ten-year horizon, the value of the contribution attributable to 1975/76 would be $367,000. This is almost certainly a minimum estimate, for without the project preparation section in the Ministry of Agriculture or the assistance provided to consultants large parts of the program would never have started. If the improvement in the rate of return is put at one-half of one percent, the value of the economists' contribution becomes $1.8 million for the year.

Direct cost estimates are only available for EPD. These came to about $120,000 and covered about one-third of the economists in the Common Service.. Thus the direct cost of the economic contribu-

tion was of the order of $360,000. One can be pretty sure that the Service at least provided an output commensurate with its costs, perhaps far in excess thereof.

The moral, if there is one, is that practicing economists should regard themselves, and be regarded, as ordinary workmen in the development process. They have useful contributions to make in both macro and micro fields. Experience in four small African countries suggests that if they are to make that contribution they must participate in government as a matter of daily routine on a par with the lawyers, administrators, engineers and other professionals.

[Extracted from The Journal of Development Studies, Vol. 15 No. 2, January 1979, pp. 216-232. Copyright © Frank Cass and Co. Ltd., London.]

DEVELOPMENT MEASURES

THIS MAP OF THE WORLD ILLUSTRATES THE GROUPING OF COUNTRIES BY THEIR SCORES ON THE PHYSICAL QUALITY OF LIFE INDEX (SEE ARTICLE ON PAGE 95). THIS INDEX IS ONE ALTERNATIVE WAY OF MEASURING DEVELOPMENT PROGRESS, RATHER THAN USING GROSS NATIONAL PRODUCT PER CAPITA FOR THAT PURPOSE.

New Measures of Development

Anthony Pearce-Batten, Associate Editor, Development Digest

The major economic policy objective of developing countries in the postwar years has been to maximize their output of goods and services, and despite some criticism the principal measure of development progress has been GNP per capita. Developing nations, it was assumed, by and large would replicate the historical experience of the industrial countries, embarking on a period of rapid and self-sustaining growth after achieving a critical threshold of economic maturity. Social and economic disparities would then decline, much as they did in the industrial nations. Therefore, the first priority in economic development was to bring countries as soon as possible to that stage at which growth would be self-sustaining, and the benefits of progress would diffuse automatically throughout society. In the last decade, however, the assumption that progress would be certain to reach down to low-income groups has come under attack.

The perception that this process was far from automatic, and that in several countries with rapid economic growth there was no discernible improvement in the living standards of the poor population, led many to a broadening of development priorities with increased emphasis on meeting the basic human needs of the poor. As the definition of development--and thus the route toward it--changed, a search intensified for alternative measures of development progress to supplement or replace GNP per capita. To date, as the summary of the literature in the next article by Norman Hicks and Paul Streeten points out, there is no consensus on any single measure. Succeeding articles describe two alternative approaches to development measures--the Physical Quality of Life Index (PQLI), and the Social Accounting Matrix (SAM).

The analyses of the PQLI and the SAM, two very different attempts to develop a basic-needs-oriented development measure, illustrate some of the major problems which beset the search for alternative measures of progress or welfare. One problem concerns data availability. A cited advantage of the PQLI is that the necessary information is widely available although, as with GNP, the quality of the data varies. Most of the data required to construct a SAM is contained in the national income accounts, but additional survey research is necessary to collect the information on household accounts.

A second problem concerns the degree to which the development measure is an accurate reflection of the dynamics of the development process. With greater emphasis on improving distribution of benefits, there is a corresponding necessity to identify and monitor the means by which distribution is improved. Both the POLI and the SAM reflect this need. Of the POLI, it is argued that the concern is with welfare results, and not economic inputs, as in the GNP measure: the three PQLI elements are sensitive measures of how effectively essential services are actually reaching the population as a whole--indeed each measure purportedly monitors several different delivery systems. The SAM relies on inputs, but seeks to analyze

the systemic interactions and transformations in a national economy necessary to effect a rise in the living standards of the poor.

The Physical Quality of Life Index, presented by Morris D. Morris, is a simple measure, with three familiar ingredients: literacy, infant mortality and life expectancy--and its simplicity is a major source of both its appeal and the criticism it has received. In contrast, the Social Accounting Matrix (SAM) is almost dauntingly complex. In one respect, it is a 'snapshot at one particular moment' of a national economy, which outlines the structure and nature of production, the distribution of income by households, and the composition of their expenditures. The SAM is a condensation of reality into a kind of input-output matrix, which functions within a dynamic model that simulates the interaction between the various components of the production structure, and between the production structure and income distribution. The authors emphasize that efforts to improve income distribution must necessarily consider the structural constraints, as well as the changes in production structure that such improvements would effect. Because of these interactions, they state, changes in income distribution are likely to occur rather gradually.

While most of the information necessary to construct a SAM is available, it is often ill suited for the analysis of distribution and poverty-linked issues. "The important thing is to integrate questions of poverty and inequality in the aggregate economic framework," argue Pyatt and Thorbecke. "One of our main recommendations is that work on national data systems can and should be reorganized so that planning can be concerned with poverty and inequality as well as growth." There are indications that government statistical offices in some developing countries are in fact collecting the kind of data necessary to construct a SAM, and SAMs are or have been built in at least a dozen diverse countries including Saudi Arabia, Sri Lanka, the Philippines, Malaysia, and Indonesia, raising the prospect of cross-national comparisons of policy measures. At the same time, as this issue of the Digest goes to press, both the World Bank and the United Nations Statistical Office are embarking on major programs to expand the availability of data on household and personal living standards. The UN Statistical Office is to initiate a major program to enhance national capabilities to conduct household surveys. The World Bank's Living Standards Measurement Study is to explore and assess the existing methods of measuring living standards, ranging from the conceptual links between household expenditures, welfare and the national accounts, to operational and methodological issues of measurement and data processing and storage.

Indicators of Development: The Search for a Basic Needs Yardstick

Norman Hicks and Paul Streeten

[The measurement of development efforts in developing countries has generally focused on the growth of GNP per head and related concepts. Increasingly, development economists have felt that growth of output or income by themselves are not adequate indicators of development, and that the reduction of poverty and the satisfaction of basic human needs are goals that should show up in a measure of development. There has been growing interest in designing better measures of development, including modifications of GNP, social indicators and associated systems of social accounts, and composite indices of development, which are reviewed critically here.]

Ever since economists have tackled the development problems of the less developed countries, the principal yardsticks for measurements of economic development have been GNP, its components, and their growth. Despite the many problems with national accounting in developing countries, the national accounts have continued to be the main focus of discussions of growth, the allocations between investment, consumption and saving, and the relative influence of various sectors in total value added. GNP per head is widely accepted as the best single indicator of development, both historically and for international comparisons, despite well known problems.

The heavy emphasis on GNP, or GNP per head, and their growth rates as the principal performance test (though not necessarily as the 'objective') of welfare or development was based on doubtful assumptions. Either it was assumed that economic growth has a tendency automatically to 'trickle down' to the poor; or it was

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thought that where there was no automatic tendency for the benefits from growth to spread to the poor, governments would take corrective action. Some authors insisted that concern with greater equality of income distribution, with alleviating poverty, or other social aspects of development was premature since it would reduce savings, investment and work incentives, and therefore growth.

In the light of the experience of the last 25 years, neither of these assumptions turned out to be generally valid. Highly concentrated and unequal growth was observed in some countries for prolonged periods; there was no universal tendency for growth to spread. Nor did governments always show signs of correcting gross inequalities. Doubt was cast on the need for inequality to promote growth when no correlation between unequal income distribution and high growth rates was established. Inequality and poverty were found not to be a necessary condition of growth and indeed were often an obstacle to it.

Disappointment with GNP per head and its growth as policy guides led to greater emphasis on employment and redistribution. But it was soon seen, on the one hand, that unemployment in the sense in which the term is used in the developed countries was not the problem in the developing countries. On the other hand, redistribution from growth only yielded very meager results. Furthermore, it is now clear that mass poverty can coexist with a high degree of equality, and that reductions in absolute poverty are consistent with increases in inequality. Concern has shifted to the eradication of absolute poverty, particularly by concentrating on specified basic human needs. Meeting these needs in nutrition, education, health and shelter may be achieved by various combinations of growth, redistribution of assets and income, restructuring of production, and reducing population growth. It is the composition of production and its beneficiaries, rather than indexes of total production or of income distribution, that have become the principal concern in this connection. This new focus on meeting basic human needs points to the need for an indicator or a set of indicators by which deprivation can be judged and measured, and policies directed at its alleviation and eradication can be initiated and monitored.

The problems inherent in using GNP as a measure of social welfare have been recognized almost since the inception of national income accounting. This paper identifies and reviews four different approaches to the measurement problem:

(1) adjustments to GNP, through which modifications of standard national income accounting concepts are undertaken in order to capture some of the welfare aspects of development and to improve international comparability;

(2) social indicators which attempt to define non-monetary measures of social progress;

(3) the related social accounting systems which attempt to provide an organizing framework for some of these indicators;

(4) the development of composite indices which combine various social indicators into a single index of human and social development or the 'quality of life'.

In addition to these four broad areas, efforts have been made to design an adequate measure of income distribution, and to count the numbers living below a defined poverty line. We discuss this briefly under the 'adjustments to GNP' approach rather than attempting to review the extensive literature on this subject.

Adjustments to the GNP Measure

Despite the overwhelming attention to growth, the deficiencies of GNP per head as an indicator of economic development have been apparent to many for some years. Pigou already had pointed out that economic welfare comprises not only national income per head, but also its distribution and the degree of steadiness or fluctuation over time. Measurement problems become apparent when one attempts to make inter-country comparisons of GNP per head. Part of the problem arises from the fact that official exchange rates do not measure relative domestic purchasing power, since a large portion of marketed GNP does not enter into world trade. In addition, trade policies often create distortions in nominal exchange rates, so that they fail to reflect the true value of even that proportion of GNP which is traded.

Colin Clark was one of the first to attempt in 1940 to convert national accounts using purchasing power parities. This means measuring the output of each country at a common price level, usually international prices. The most recent and complete work on purchasing power parities has been undertaken by Irving Kravis et al. The results of this research suggest that the GNP of India, for instance, should be adjusted upward by a factor of 3.5 for comparison with U.S. incomes in dollars; other countries would be adjusted by a somewhat smaller margin. Even these kinds of adjustment for the purchasing power of different currencies, however, cannot eliminate all the problems of comparing GNP across countries. For instance, because of climatic conditions greater expenditures may be required for clothing and shelter in the colder parts of the world in order to survive, while dry tropical zones require more expenditure on irrigation. Evaluations of non-tradable products, particularly public and other services, are difficult and subject to conceptual problems.

In any case a great deal of work is necessary, covering hundreds of goods and services, in order to estimate accurately purchasing power parities. Unless a short cut or reduced information method is developed, it will be difficult to make wide use of this approach.

Nordhaus and Tobin attempted in 1972 to adjust GNP so that it would be a better 'Measure of Economic Welfare' (MEW). This approach entailed subtracting from GNP an allowance for devense expenditures and other "regrettable necessities," such as the "disamenities" of urbanization (pollution, congestion, crime, etc.), while adding an estimate of the positive value of leisure and the services of consumer durables. At the same time, Nordhaus and Tobin reclassified health and education expenditures as investment, rather than consumption. The final result produced a MEW for the USA that was substantially larger than GNP (about twice), largely because of the high value imputed to leisure (the measure of which raises great difficulties) and other non-market activities. The growth rate of MEW for the USA between 1929 and 1965 was somewhat lower than that for GNP, mainly because of the larger value of leisure and non-market activities in the base year (1929), reducing the proportionate rate of growth, and partly because of the growth of defense expenditure and urban "disamenities".

Denison and others have criticized this approach on the ground that GNP was never meant to measure welfare, and attempts to adjust it only confuse the concept. From the point of view of indicating the satisfaction of basic needs, the Nordhaus-Tobin corrections raise certain difficulties. 'Regrettable necessities' are subtracted from GNP, because "we see no direct effect of defense expenditures on household economic welfare... If there were no war or risk of war, there would be no need for defense expenditures and no one would be the worse without them." But similar reasoning could be applied to the components of basic needs. We do not want medical services for their own sake; if it were not for disease and accidents, we would not need to incur this expenditure. The same goes for shelter against the cold. A logically consistent application of the Nordhaus-Tobin principle would lead to an inclusion in the national income of only those items that we do not really need, the inessentials and frills, contrary to the judgment of those who wish to exclude all frivolous luxuries from our national income accounts. If it were possible to distinguish precisely between 'goods', 'bads', and 'anti-bads', we could deduct from national income anti-bads made necessary by external threats (defense), by nature (heating), by the productive system (anti-pollutants), or by advertizers (deodorants). In fact, it is not possible to distinguish between good and bad artificially created wants without introducing arbitrary value judgments, especially when applied across cultures to developing countries.

It might be possible to incorporate some of the items captured by social indicators which incorporate generally acceptable value

judgments by GNP adjustments. Thus, life expectancy could be allowed for by using expected lifetime earnings instead of annual income per head or, more crudely, the product of average income per head and life expectancy. The consumption benefits of literacy could be allowed for by imputing the value of services from education as a durable consumer good, etc. (The benefits of literacy as a durable investment good already show in the form of higher productivity.) Distribution could be allowed for by taking the median or the mode rather than the mean income, thus eliminating the excessive weight given to the rich by the mean, or by multiplying the mean income by 1 minus the Gini coefficient.

Adjustment to GNP for distributional value judgments can be made by weighting different components of the national income according to who receives them. Such a redefinition would, however, eliminate the distinction between the national income and its distribution. Ahluwalia and Chenery (1974) have suggested that the growth rate of GNP in itself is a misleading indicator of development, since it is heavily weighted by the income shares of the rich. A growth of 10% in incomes of the upper 20% will have more impact on the aggregate growth rate than 10% growth (or even doubling) in incomes of the lower 20%. They suggest two alternatives: either the equal weighting of each decile of income recipients, or the introduction of 'poverty weights' which would place more weight on the growth of incomes for the lower 40%. The result is a revised aggregate growth rate which makes an allowance for differences and changes in income distribution.

Another approach would be to use simply the absolute income level of the lower 40% as the appropriate indicator to which development policies should be related. This has the advantage of shifting the focus away from the income of the well-to-do, a politically sensitive subject in many countries, to the level of living of the poor. Progress in reducing poverty can be judged, however, only if the income level of the poor can be compared with some standard minimum which reflects a 'poverty line'. The general approach adopted by many is to calculate that level of income at which the average family consumes a nutritionally adequate diet, usually defined in terms of calories. Those families (or individuals) not having this income are therefore judged to be below the poverty line, and comprise the poverty target group.

The shortcomings of this approach are many, and will be discussed here only briefly. First, examination of family income and food consumption ignores the important problem of distribution of food and other amenities within the family. It seems clear that in many countries women (who, in some societies work harder than men) and children receive less than an 'adequate' amount of food even when the family's total consumption is judged to be 'adequate'. Poverty line measures do not indicate how far families are below the poverty line so they do

not show improvements that take place below this line nor suggest the condition of those brought barely above the line. They therefore conceal the efforts required to reduce poverty. A. K. Sen has proposed a weighting of individuals on the basis of how far they fall below the poverty line, thus combining poverty line and income distribution approaches.

In addition, the concept of 'nutritionally adequate' is difficult to define since caloric needs vary widely with climate, body weight and height, level of activity, age and other factors, and even for the same person in the same conditions from day to day. Household income surveys generally show that many families below the poverty line could consume an adequate diet by purchasing a different and more efficient basket of foods which are available, but which is rejected on grounds of taste, variety, etc. Families living below the 'poverty line' are often found to spend money on non-basic items such as drink and entertainment. Even with an income above the poverty line, a family may not be able to purchase essential goods and services which are in inadequate supply or controlled by the public sector (such as health, education, water supply), or they may have to rely on less efficient and more costly alternatives in the private sector (traditional healers, private water deliveries, private schools). The main basis of the basic needs approach, in fact, stems from the view that raising incomes alone is insufficient in view of the inefficiencies in the consumption patterns of the poor and the lack of availability of essential goods and services. Thus, any measure of poverty income, no matter how carefully derived, will be inadequate for measuring basic needs.

Social Indicators

An alternative approach is to develop better indicators of human, social and economic development which cover aspects that cannot be reflected in most income-based measures. These so-called 'social indicators' attempt to measure the development of health, nutrition, housing, income distribution, as well as other aspects of cultural and social development. A great deal of work has been undertaken by various agencies to compile sets of social indicators, including the UN (1975), OECD (1976), AID (1976), UNESCO (1977) to mention only a few.

In theory, social indicators should be more useful in cross-country comparisons, since they avoid the exchange and valuation problem. In fact, the figures are often unreliable and not comparable, particularly because of different definitions used in collecting data. Many data are based on limited sample surveys or other highly inaccurate data collection methods. Differences observed in social indicators between countries often reflect these statistical and definitional variations in the indicators rather than real

differences in social development. Nevertheless this constitutes a challenge to collect better, more comparable data.

Unlike the national accounts which use many prices to combine heterogeneous items, there is no obvious way to combine different social indicators. Consequently, problems arise in absorbing the content of a large number of socio-economic indicators and in any attempt to draw general conclusions. The movement to develop social indicators, furthermore, has suffered from a lack of clear perception of purpose. The term 'social indicators' has itself been used very loosely to encompass a whole range of human, economic, social, cultural and political phenomena. The need to supplement the GNP as an indicator of economic development has become confused with a search for indicators of other aspects of development, or for an indicator of the 'quality of life'. The latter concept has generally been taken to cover concepts such as security, peace, equality of opportunity, participation, and personal satisfaction, all of which present difficult measurement problems. It has never been clear whether the search was for an alternative to GNP, or a complement or a supplement.

Although we do not as yet have a unifying conceptual framework for these indicators, and despite the problems mentioned, social indicators do have certain advantages over GNP per head. First, they are concerned with ends as well as means, or at least with intermediate ends nearer to the ultimate end of a full and healthy life than are the aggregate or average production measures. Even those social indicators that measure inputs (e.g. hospital beds for 1000 population or school enrolment rates) rather than results (life expectancy, morbidity, literacy) attempt to capture inputs that are nearer to the desirable results than GNP per head.

Secondly, many social indicators say something about the distribution as well as the average, because the skewness at the upper end for income per head does not occur or is much less in these measures. There is practically no limit to how much income a man can receive, but the maximum life span is limited. (The mode or the median for income per head can, however, eliminate skewness and reflect some aspects of distribution in the average.)

Some indicators are better than others for showing also the distribution of basic needs deficiencies, since they are constructed on an either/or, have/have-not basis. Thus, measures such as literacy, access to clean water, and primary school enrolment can be used to indicate the percentage of the population having basic needs deficiencies below a defined minimum in each of these important sectors. Measures such as life expectancy, infant mortality, and average calorie consumption are less informative since they average

the statistics of rich and poor alike. There seems to be a need to develop more specific measures related to the poor, such as life expectancy or calorie consumption indicators for those in the lower quintile of the income distribution, for women, for rural dwellers, etc.

Thirdly, while GNP per head follows an ascending order from the poorest to the richest countries, some social indicators are capable of catching something of the human, social, and cultural costs of opulence (the diseases of affluence like heart disease, stomach ulcers or deaths in automobile accidents), as well as poverty. They can, in principle, register some of the shared global problems, such as pollution, cultural dependence or interdependence, etc., and reduce the false hierarchical and paternalistic impression that may be created by purely economic indicators. As a result, a different meaning can be attached to the 'gap' between the so-called developed and developing countries. The GNP measure points to 'catching up' and suggests a race. Social indicators can point to shared values and problems, to alternative styles of development, to the opportunities for learning from one another. Reducing or closing the international 'gap' in life expectancy, literacy, infant mortality, or morbidity would appear to be a more sensible objective, and can be achieved at much lower levels of GNP per head and therefore much sooner, than reducing the 'income gap'.

Inputs vs. results. Whether social indicators should reflect inputs or results depends upon their purpose. For performance testing there is something to be said for choosing indices that measure results, impacts, or outputs, since these are closer to what we are trying to achieve. Furthermore, measures of inputs can introduce biases toward certain patterns of meeting needs which may not be universal. For instance, a country with fairly acceptable health standards should not be encouraged to acquire the same number of doctors as one with serious health problems. Another drawback is that the number of doctors does not measure the distribution of these doctors and their medical services, or the degree of their specialization. Resources may be deployed in inefficient ways, failing to benefit the poor. Measures such as infant mortality and life expectancy, on the other hand, indicate the degree to which medical needs have been met. In general, output measures are better indicators of the level of welfare and basic needs achievement. Some important outputs are also inputs: health, education and even nutrition are valued not only in their own right, but also because they raise the productivity of present and future workers.

Input measures, such as doctors or hospital beds per 1000 or enrolment rates in schools, on the other hand, also have their uses. They may reflect government intention, commitment and efforts to pro-

vide public services. For purposes of assessing policies and monitoring performance, both sets of indicators are necessary. Input measures are useful indicators of resources devoted to certain objectives (though these resources can be misdirected). To the extent to which we know how to link inputs to results, i.e. to have a 'production function', we can trace the connections between means and ends. Even where we do not have knowledge of a 'production function' (e.g. linking expenditures on family planning to a decline in the fertility rate), the combination of input and output measures presents the raw material for research into the causal links between the two. And where output measures cannot be readily found, it might be necessary to fall back on measures of inputs as useful proxies.

GNP vs. Social Indices

Several studies (McGranahan et al., 1972; United Nations, 1975) have indicated a high correlation between economic indicators, including GNP and social indicators. This might suggest that GNP can be used as a proxy measure of social development. Morawetz (1977) found that there was a weak correlation between the level of GNP and indicators of basic needs fulfillment, and even less correlation between the growth of GNP and improvements in basic needs indicators. Sheehan and Hopkins (1978) concluded, however, that "the most important variable explaining the average level of basic needs satisfaction is per capita gross national product." These contradictory results appear to arise from the use of different selection of indicators, sources of data, and country samples, as well as different interpretations of results. Many scholars include in 'social' indicators non-monetary measures of economic performance, such as newsprint or energy consumption or the ownership of automobiles and radios. These economic indicators are almost always highly correlated with GNP, and at times have been suggested as a shortcut to estimating internationally comparable income levels. Some authors exclude the developed countries, whose high levels of both GNP and social development might dominate the sample. Different results are obtained according to whether we include or exclude the centrally planned economies, the OPEC countries, and the very small LDCs.

Correlations based on 1970 data from the World Bank's Social Data Bank are shown in Table 1. The results for 7 social indicators show a modest correlation with GNP (average $r^2 = 0.50$), while a sample of 5 economic indicators show a somewhat higher correlation ($r^2 = 0.71$). However, when the social indicator data are disaggregated into samples of developing and developed countries, the correlation for both groups drops significantly ($r^2 = 0.25$ for developing countries, 0.18 for developed). Similar declines in the correlation values are also found when the economic indicators are disaggregated. Consequently, it would

TABLE 1: Correlation of Indicators with GNP, 1970

(Correlation values = r^2)

	All countries	Developing	Developed	Sample size
Social indicators				
Expectation of life at birth	0.53	0.28	0.13	102
Calorie consumption (as % of required)	0.44	0.22	0.02	103
Infant mortality	0.42	0.34	0.25	64
Primary enrolment	0.28	0.24	0.05	101
Literacy	0.54	0.47	0.16	70
Average persons per room (urban)	0.58	0.08	0.29	34
Housing units without piped water (%)	0.74	0.13	0.36	36
Average *	0.50	0.25	0.18	
Economic indicators†				
Newsprint consumption	0.79	0.20	0.46	85
Automobiles	0.85	0.59	0.46	102
Radio receivers	0.43	0.14	0.07	97
Electricity consumption	0.67	0.30	0.24	102
Energy consumption	0.82	0.28	0.49	99
Average	0.71	0.30	0.34	

Source: Based on data taken from the World Bank's Social Data Bank. Excludes centrally planned economies and countries with a population of less than one million.

* Simple unweighted arithmetic means of the r^2.
† All economic indicators are on a *per capita* basis.

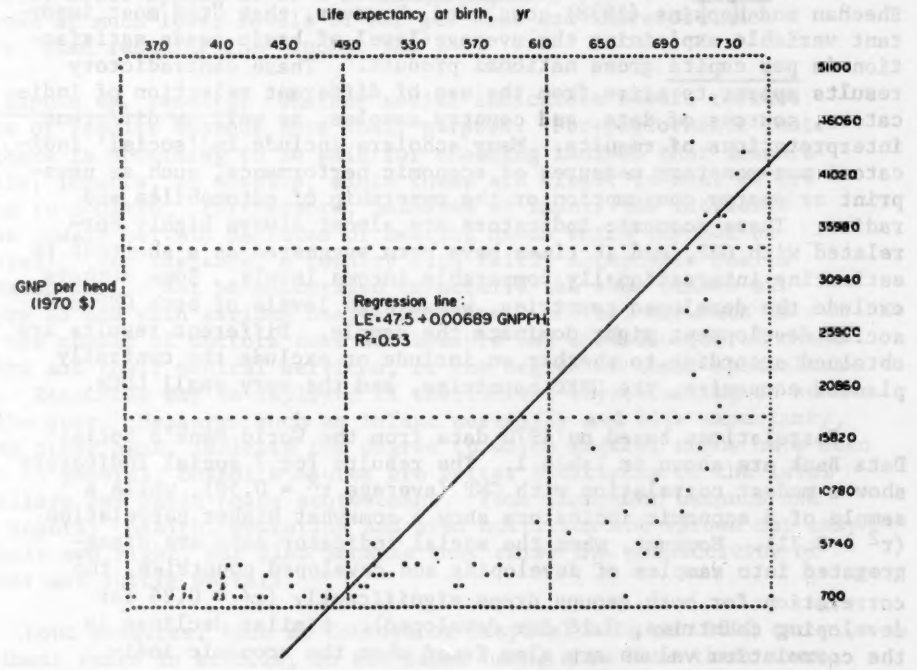

Figure 1. *GNP and life expectancy* (1970)

appear that studies which examine only social variables for developing countries are apt to discover a poor relationship, while those that consider economic and social variables for all countries are likely to find somewhat better relationships.

One reason why social indicators are not more highly correlated with GNP per head is that the relationships are often distinctly non-linear. Indicators such as life expectancy, literacy, and school enrolment have asymptotic limits which reflect biological and physical maxima. These limits are often reached by upper-middle-income countries, so that further increases in income show little gains in social indicators. For instance, life expectancies of 70 years of age were reached by countries with income per head in 1970 as low as $2000, while further increases do not occur as incomes increase to $5000 (See Figure 1). Similarly, most countries have attained close to 100% literacy by the time their income per head reaches the $2500 level. Conversely, countries below $500 GNP per head show a wide variety of social development which is largely unrelated to the level of GNP. Other social indicators show similar patterns. The cluster of points along either axis in Figure 1 indicates the lack of correlation at both the high and low income levels. A much better correlation could be developed using some sort of non-linear relationship; in the case of life expectancy, for example, a semi-log function increases the r^2 from 0.53 to 0.75. However, specification of a non-linear function would obscure the fact that strong correlation exists only among the middle-income countries. Rankings of countries by social indicators and GNP may often be very similar, but GNP per head is likely to be a misleading indicator of social development and progress in meeting basic needs, particularly when used in some linear fashion.

Social Accounting Systems

Some work has been done on developing a system of social accounts to provide a kind of national accounting framework for social indicators. Stone (1975) and Seers (1977) have proposed the use of lifetime activity sequences calculated by dividing total life expectancy into segments. Such tables would show the average years (or fraction of his life) a person could expect to spend in various mutually exclusive states. One such matrix could divide lifetime activity between school, work, leisure, retirement, etc., while another might be built on a marital sequence (single, married, divorced, widowed). Such tables would combine various important social statistics from different fields, and would be used to indicate changes over time, either actual or planned. The system presents many problems, not the least of which is its inability to incorporate fully all aspects of social development. Some indicators (income distribution, security, policy protection, pollution) cannot be readily transformed into segments of life expectancies. Furthermore, the system goes far

beyond the data available in most countries, and is thus more suited for the industrialized countries.

Other ideas have been developed for a more limited social accounting approach. The Social Accounting Matrix (SAM) of Pyatt and Round (1977) expands the traditional input-output table into a matrix which details payments made by productive sectors to different income recipients. Recipients can be disaggregated in various ways so as to indicate the distribution of income between various factors, urban/rural households, or income classes. The power of the SAM approach is that it integrates production and income distribution data in a way that gives a better view of the economy, and of the flows between sectors. It still relies, of course, on the use of GNP as a measure of welfare, and is limited in its application by the absence of good income distribution data. Terleckyj (1975) has developed a matrix framework for analyzing the impact of government programs on various social goals, as indicated by the appropriate social indicators. Since programs affect more than one social goal, the approach develops a matrix of inputs and outputs, and suggests the possibility of defining the most efficient set of programs for achieving a particular set of goals.

Composite Indices of Development

Relatively more work has gone into developing composite indices that could be used to replace or supplement GNP as an indicator of social, economic or general development. A large amount of work was undertaken by the UN Research Institute for Social Development (UNRISD) during the 1960s to develop better social indicators, including composite indicators. For instance, Drewnowski and Scott (UNRISD, 1966) developed the Level of Living Index, which was defined as "the level of satisfaction of the needs of the population as measured by the flow of goods and services enjoyed in a unit of time." The Level of Living Index itself, however, goes beyond the provision of goods and services, and considers "Basic Needs", subdivided between physical needs (nutrition, shelter, health), and cultural needs (education, leisure, security). 'Higher Needs' or 'Surplus over Basic Needs' is taken as the surplus income over some minimum level. The 'basic needs' part of the index calls for data which are very difficult to obtain for many countries, such as the amount of leisure time available, the number of people in possession of private saving, and the quality of housing. This makes the application of the index very difficult, and Drewnowski and Scott were forced to use short-cut approximations even for their limited sample of 20 countries. Furthermore, the work, once begun, was not continued after 1966 in the same form.

McGranahan et al. (UNRISD, 1972) examined 73 indicators which covered economic and social characteristics, and found that there was fairly high inter-correlation between these indicators. Through a process of elimination, he constructed a Development Index based on 18 'core indicators' which included 9 social and 9 economic indicators. The resulting index was highly correlated with GNP per head ($r^2 = 0.89$), although there were some countries (Venezuela, Chile, Japan) whose ranking was substantially different under the index. In general, the correlation of the index and GNP per head was somewhat lower for developing than developed countries. This study concluded that social development occurred at a more rapid pace than economic development up to a level of about $500 per capita (1960 prices). Some of these results are themselves, however, a product of the method employed, whereby the selection of 18 'core indicators' was based, in part, on their having high inter-correlations with the other indicators. The UNRISD team found, for instance, that the country rankings remained virtually unchanged when the number of indicators was reduced from 18 to 10.

A study by the United Nations-ECOSOC in 1975 sought to analyze development by ranking 140 countries by seven indicators other than GNP. These included two social indicators (literacy, life expectancy) and five economic indicators (energy, manufacturing share of GDP, manufacturing share of exports, employment outside agriculture, number of telephones). An overall rank for each country was calculated by giving equal weight to the ranks under each separate indicator. Arranging the results by quintiles, and comparing with GNP, the UN indicated that the overall index was closely associated with the ranking by GNP. A similar study by the OECD Secretariat (1973) used regression techniques for six variables to establish a predicted GNP per head index for 82 developing countries. A more recent paper by the OECD/DAC (1977), however, concluded that "per capita GNP still appears to be the best measure" of the level of development.

A more recent study of the use of a composite index has been undertaken for the Overseas Development Council (ODC) by Morris D. Morris [see next article]. Morris's Physical Quality of Life Index (PQLI) uses three simple indicators with equal weights to attempt to measure the fulfillment of 'minimum human needs': life expectancy at age one, infant mortality, and literacy. Morris argues that the use of indicators for judging performance under basic needs criteria should concentrate on indicators of outputs or results rather than inputs. Input measures, he feels, do not measure success in meeting the desired goals, and may lend an ethnocentric bias to the means employed. The use of only three indicators based on widely available data permits the calculation of the PQLI for a wide range of countries, and facilitates the examination of changes in the index over time.

The weighting system of the PQLI is arbitrary, however, as there is no rationale for giving equal weights to literacy, infant mortality and life expectancy at age one. It is not possible to prove that the PQLI gives a 'correct' index of progress on human needs, as opposed to some alternative index having different weights or a different selection of component indices. It is not clear what is gained by combining the component indices with a weighting system that cannot be defended. While Morris' index has received much attention in the popular press, most scholars find it difficult to accept the results of a composite index without a stronger theoretical foundation.

Despite the potential attractiveness of having a single index of socio-economic development, there is little theoretical guidance to govern either the choice of indicators, the correct scaling of component indices, or the appropriate weights. Moreover, any index that relies only on ranking neglects the distance between ranks. Scaling problems arise when raw data on social indicators are converted into component indices ranging from 0 to 100. For instance, a reasonable range of values for life expectancy could be either 40-75 or 40-100 years. A country with a life expectancy of 60 years will obviously have a different 'score' depending on the scaling chosen (57 or 33), and this will materially change the composite index. Furthermore, the scaling system need not be linear. Drewnowski used "expert opinion" to derive a linear scale system reflecting set levels of basic needs satisfaction. McGranahan et al. developed an elaborate system of "correspondence points" to determine the appropriate scale range, and utilize non-linear (logarithmic) scaling for many indicators. Morris simply took the range of the data for each indicator with the 'worst' country being defined as zero and the 'best' as 100.

There is an even more difficult problem in the proper weights to be used for combining component indices into a composite. Drewnowski tried both equal fixed weights and a system of sliding weights under which deviations from the normal were given more weight than indices close to the normal. The shift in the weighting system did not materially affect the country rankings, which were highly correlated with the rankings of countries by GNP per head. McGranahan's weighting system gave greater weight to the component indicators that had the highest degree of inter-correlation with the other indicators, a somewhat dubious method. One would think that the absence of correlation would be at least an equally valid criterion. He also found that moderate changes in the weighting system did not affect the level of each country's index, or its ranking; this is a logical result of having high inter-correlations among the components, since high correlation implies that any one component is a good substitute for any other. The UN-ECOSOC study gives equal weight to the country ranks of the social indicators, thus avoiding,

in a certain sense, the scaling problem. As mentioned above, the PQLI gives equal weight to each of the three components without ascertaining if this implies the correct 'trade-off' between the various components. None of these studies indicates that much effort was devoted to developing a theoretically sound rationale for the weighting system.

Because of these problems, it might well be argued that a composite index is either unnecessary, or undesirable, or impossible to construct. It is unnecessary if the components are correlated with one another, because then any one of the component indicators by itself will serve as an adequate index. If, on the other hand, the components move in different directions in cross-country comparisons and time series, any single index value could be regarded as an undesirable obscuring of important issues. To have the same index for a situation in which mortality is high and literacy low as for one in which literacy is high and mortality low, for example, seems to imply an equal 'trade-off' between the particular differences in literacy and life expectancy. Unless the basis for such an evaluation can be established, all weighting remains arbitrary and misleading, and composition is impossible. The case for considering the two indices separately is the same as the case for having an index independent of GNP.

If the interpretation of basic needs were taken to mean that all such needs, being 'basic', would have to be met together, so that trade-offs between different basic needs were ruled out, a composite index would not be necessary. As long as the 'package' of basic needs has not been fully met, no amount of additional satisfaction of any one component could compensate for the slightest deficiency in any other, so that a composite indicator would be ruled out. And once all basic needs had been met, again no composite index would be required. But we are not advocating such a literal interpretation of 'basic needs'.

Conclusions

The current discussion of basic-needs-oriented development focuses on the alleviation of poverty through a variety of measures other than merely redistribution of incremental output. Such a focus supplements attention to how much is being produced by attention to what is produced, in what ways, for whom and with what impact. Obviously, the rapid growth of output will still be important to the alleviation of poverty, and GNP per head remains an important figure. What is required are some indicators of the composition and beneficiaries of GNP which would supplement the GNP data, not replace them. The basic needs approach, therefore, can be the instrument for giving the necessary focus to the work on social indicators.

As a first step, it might be useful to define the best indicator for each basic need. At present, the essential basic needs may be considered to cover six areas: nutrition, basic education, health, sanitation, water supply, and housing and related infrastructure (see Streeten and Burki, 1978; this list is not intended to be exhaustive, nor do all needs listed have the same status--ore might, for example, wish to add transportation and energy). Because there are six basic needs, there need not necessarily be only six core indicators; more than one indicator may be necessary to measure progress adequately in any one area, while one indicator may serve more than one basic needs sector.

The problem of selecting the appropriate index in each field is best taken up by technical experts in each sector. However, to give a preliminary indication of the indicators which might be included, the following have been identified:

Health:	- Life expectancy at birth;
Education:	- Literacy - Primary school enrolment (as percent of population aged 5-14);
Food:	- Calorie supply per head or calorie supply as a percent of requirements;
Water supply:	- Infant mortality (per thousand births) - Percent of population with access to potable water;
Sanitation:	- Infant mortality (per thousand births) - Percent of population with access to sanitation facilities; and
Housing:	- None.

The core indicators identified here attempt to follow the philosophy of stressing measures of results rather than inputs. Infant mortality is assumed to be a good indicator of the availability of sanitation and clean water facilities because of the susceptibility of infants to water-borne diseases, and data on infant mortality are generally more readily available than data on access to clean water. While literacy is a good general measure of progress in education, the percent of the relevant age group enroled in primary school is also included to measure country effort. Input measures have also been identified for water supply and sanitation as supplementary measures. It has not been possible, however, to identify a satisfactory measure of housing needs. The only readily available indicator is people per room, but this really does not capture much of the quality of housing, only the number of rooms which in turn is a

very rough index of crowding. Ideally, these indicators should be supplemented by data about distribution of calories per head, etc.

If an acceptable system of weights could be developed, it might be possible to combine the core indicators into a composite basic needs index. The chances of an acceptable system of weights being developed, however, are extremely small: despite considerable research, no one has come close to developing a rational weighting system. Some may question the desirability of such a composite index, even if it could be constructed with an acceptable rationale.

Instead of attempting to develop a composite index of basic needs, a useful alternative may be to narrow the range of indicators to one or two which correlate highly with basic needs fulfillment. This approach would serve the need of those who desire a single number for making quick judgments on social performance, without introducing the problems of weighted composite indices. The prospects for doing this are enhanced considerably by the fact that many of the so-called 'basic needs' are, in fact, inputs rather than ultimate goals. Certainly nutrition, water supply and sanitation are valued because they improve the health status of the population. To a more limited extent, this is also true of housing and education. All of these can be considered to be inputs into the health 'production function'. They may be valued for reasons other than their influence on health status, but a high association between the various core indicators can be traced to their impact on health. Therefore, it could be argued that some measure of health, such as life expectancy at birth, would be a good single measure of basic needs.

In a sense, life expectancy is a kind of weighted composite of progress in meeting physiological basic needs. It has the advantage of capturing the impact on individuals, not only of non-market factors but also of income net of taxes, transfer payments and social services, without raising all the difficulties of income per head measures such as the appropriate unit (individual, household or family), the appropriate magnitude (capital, consumption, income), the appropriate set of prices (market prices, international prices), what to value as final goods and what as costs, etc. For many purposes it might be regarded as superior not only to a composite index of social indicators but also to GNP and to indices of income distribution. It is possible for two countries to register the same GNP per head and the same ratio of income accruing to the bottom 20%, and yet to have different average life expectancies. (For some purposes, e.g. if life expectancies cluster very near one another, it would be useful to add a measure of progress in education, such as literacy.) It is, of course, possible to have a long and miserable life, and one might wish to put an upper limit to the desired life span. But at low income levels, there is a high correlation between morbidity and mortality.

In using a single indicator, it is, however, important to guard against two dangers: the danger to interpret the result in a uni-dimensional way, and the danger to interpret inputs in a unidimensional way. Life expectancy can be increased by measures that affect different age groups differently. Improved nutrition, for example, may affect life expectancy above one year, whereas women's education may affect infant mortality. The second danger is that the improvement of a health indicator like life expectancy will focus too much attention on health measures generally, and doctors, clinics and nurses specifically, whereas the 'production function' for life expectancy may include a number of thrusts not obviously related to health, like improved jobs, earnings, environment, etc. Just as we now know that reductions in the rate of population growth are not simply functions of improved family planning, so improved health and longer life are not simply functions of improved health delivery systems. But as long as the indicators are not identified with uni-dimensional results or uni-causal remedies, there is much to be said for a simple system of recording and monitoring.

[Extracted from "Indicators of Development: The Search for a Basic Needs Yardstick," World Development, Vol. 7, No. 6, June 1979, pp. 567-580. Copyright © Pergamon Press Ltd., Oxford, England.]

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The Physical Quality of Life Index (PQLI)

Morris D. Morris

[The index described here supplies a comparison among countries in their progress in extending health, sanitation, education and other benefits to their populations. The formation of the index, its relation to other measures, and some of the results of applying it are presented.]

In response to disappointment with the perceived results of the growth-oriented strategies of the past quarter century, both rich and poor countries are exhibiting a renewed interest in the possibility of meeting the minimum human needs of the world's poorest people. Some see equity as a desirable objective to be achieved even at the cost of some growth. Others recognize it as a necessary, although not sufficient component of any humane growth strategy.

Whether such strategies are to be enduring or a fad, whether their objectives are serious targets or slogans, they pose as never before the need to measure not only total economic output and the composition of that output, but also how economic benefits are distributed. There never has been an easy way to measure this type of performance. Gross national product (GNP) is the most widely accepted measure of progress. However, while per capita GNP measures general economic performance within and among countries, it is unable to show how output is distributed among people in poor (or even in rich) countries. To the extent that development planners within poor countries and aid dispensers in donor countries now focus more directly on projects that emphasize distribution of benefits, they need not

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only new planning strategies but also additional measurement systems.

Choosing the Indicators

Six criteria that a measure of international socio-economic performance should meet are the following:

1. It should not assume that there is only one pattern of development.
2. It should avoid standards that reflect the values of specific societies, i.e. avoid ethnocentricity.
3. It should measure results, not inputs.
4. It should be able to reflect the distribution of social results as well as their levels.
5. It should be simple to construct and easy to comprehend.
6. It should lend itself to international comparison.

A number of factors make life expectancy, infant mortality, and literacy appropriate indicators for measuring physical well-being and assessing progress toward identifiable targets. Although data on these three social indicators still are uneven in quality--especially in many developing countries--they are widely available. A further major advantage of these indicators is that they measure development results rather than inputs. Being relatively un-ethnocentric and objective, they are reasonable standards for performance comparison. Life expectancy at age one and infant mortality can be good indicators of important aspects of social progress, since they represent the sum of the effects of nutrition, public health, income, and the general environment. At the same time, the two indicators reflect quite different aspects of social interaction. Preliminary work suggests, for example, that infant mortality is a sensitive surrogate for the availability of clean water, the condition of the home environment, and the well-being of mothers, while life expectancy at age one reflects nutrition and general environmental characteristics outside the home.

Literacy, too, is a useful indicator, because it is both a measure of well-being and a skill that is important in the development process. The extent to which poor groups are literate helps determine the extent to which they do share, or will be able to share, the benefits of economic growth; how widespread literacy is also provides a good indication of the position of women in society. Moreover, literacy does not become widespread without sufficient advancement in a society to make it a widely desired skill.

Creating a Composite Index

Having determined three indicators that meet the six criteria, how can these different measures--life expectancy at age one, infant mortality, and literacy--be combined into a single measure? The PQLI is based on a simple indexing system. For each indicator, the performance of individual countries is placed on a scale of 0 to 100, where 0 represents an explicitly defined "worst" performance and 100 represents an explicit "best" performance. Once performance for each indicator is scaled to this common measure, a composite index can be calculated by averaging the three indicators, giving equal weight to each of them. The resulting Physical Quality of Life Index thus is scaled automatically on a range of 0 to 100. Some countries have data that go back a very long time, while for many countries the data are still unsatisfactory. Comparative national data on a worldwide scale only began to become available in the 1950s, after the formation of the United Nations. The bottom and top limits for the PQLI indicators are based on these post-1950 data.

Indexing the indicators. The task of placing historical experience on a scale of 0 to 100 is different for each indicator. Basic literacy, of course, poses no problem. Data are reported as a percentage of the population fifteen years and older who are literate; the percentage figures correspond to the index numbers.

The scaling of the other two indicators, however, is not quite as simple. Infant mortality is expressed as the number of infant deaths per thousand live births. The worst conceivable situation would be one in which every child died within the first year--that is, an infant mortality rate of 1,000. The best situation would be on in which no person died within the first year--an infant mortality rate of 0. This range of 0 to 1,000 would allow for easy conversion to a scale of 0 to 100. However, a scaling that leads to the concentration of all the observations within a very narrow part of the 0 to 100 range will not show the rank, spread, and cluster effects that it is desirable to emphasize. Gabon's infant mortality rate of 229 deaths per thousand live births is the worst recorded by the United Nations for any country since 1950. It makes sense to exclude from the index that portion of the range that is not needed to express current, recent, or probable rates. So the worst infant mortality on record since 1950 (229 per thousand) is assigned the value of 0 on the 0 to 100 scale. The best infant mortality achieved to date has been 8 per thousand, in Sweden. Medical authorities doubt that any nation can achieve much better performance in its infant mortality than this in the foreseeable future, certainly no better than 7 deaths per thousand by the year 2000; thus 7 deaths per thousand is the high (100) end of the scale. Using a range of 229 to 7 deaths per thousand means that a 2.22-point

change in the infant mortality rate will show up as a 1-point change in the infant mortality index. If a country were engulfed by a great social catastrophe that raised its infant mortality above 229, the index would have to show the result as a negative number. This does not seem likely for more than a few, relatively small countries.

The lower and upper limits of life expectancy at age one were established similarly. With data for life expectancy at birth and for infant mortality, it is possible to calculate life expectancy at age one. The lowest reported life expectancy at age one for the entire post-World War II period is 38 years for Vietnam in 1950. This figure is used as the low (0) end of the life expectancy index --even though this poses the possibility of encountering a negative number for this indicator some time in the future. The upper limit of the average life expectancy at age one index was determined on the basis of the best available estimates of what average life expectancy at age one is likely to be at the end of the century under the best national conditions. It is widely agreed that large improvements in longevity will only occur if there is a general breakthrough in the study of geriatrics. On the basis of a survey of scientific expectations, it is reasonable to set the upper limit of achievable life expectancy at age one at 77 years, two years above the current best (Sweden, with 75 years). This means that a change in life expectancy of .39 years will result in a one-point change in the index.

Thus the range for each index was based on an examination of the best and worst in historical experience, modified by expectations of possible change. The life expectancy at age one index ranges from 38 to 77 years; the infant mortality index ranges from 229 to 7 per thousand live births; the literacy index ranges from 0 literacy to 100 percent literacy. Table 1 shows for three countries how these indicators were changed to index numbers, and then averaged (equally weighted) to form the PQLI value.

The PQLI is comprised of three indicators that have no obvious relationship to each other. Each provides important information about the social process. Each was selected because it met established criteria. The PQLI is a summation of complex social interrelationships for which there is as yet no theoretical explanation that imposes or even suggests any set of weights. Because there is no reason to treat any one indicator as more important than another, equal weight was assigned to each of the components of the composite index.

Because it sets fixed lower and upper limits, the PQLI measures only movement in relation to those fixed limits. Unlike per capita GNP, the PQLI seeks to measure only a very specific type of perform-

ance for which there is an upper limit of achievement. As country performance moves close to the top of the index, there is less to measure. For example, Sweden (with a PQLI of 97) is the best provider and Guinea-Bissau (with a PQLI of 12) the poorest provider of the social results measured by the PQLI. There is only a slight range for improvement in Sweden: literacy is virtually universal, infant mortality is extremely low, and life expectancy is long and close to a society's attainable maximum. In effect, Sweden and a number of other developed countries--there are eight countries with PQLIs of 95 or more--have been able to cope with most of the specific problems which the PQLI measures. Their current social tasks

TABLE 1

LIFE EXPECTANCY AT AGE ONE, INFANT MORTALITY, AND LITERACY AND THEIR INCORPORATION INTO POLI VALUES
(Actual Data and Index Numbers, early 1970s)

	Life Expectancy at Age One		Infant Mortality		Literacy[3]		PQLI[4]
	(years)	Index Number	(per 1,000 live births)	Index Number	(%)	Index Number	
Nigeria	49	28	180	22	25	25	25
India	56	46	122	48	34	34	43
United States	72	88	16	96	99	99	94

[1]Years of life expectancy are converted to an index number according to the formula:

$$\frac{\text{life expectancy at age one} - 38}{.39}$$

[2]The infant mortality rate is converted to an index number according to the formula:

$$\frac{229 - \text{infant mortality rate per thousand}}{2.22}$$

[3]Literacy index numbers correspond to the actual data.
[4]Average of life expectancy at age one, infant mortality, and literacy indexes (equally weighted).

are different, and the PQLI cannot measure their progress in solving the particular problems that face them.

Countries with low PQLIs will improve their literacy, infant mortality, and life expectancy performance. The gap between where countries are and what is possible will narrow. As these specific social objectives are realized, the POLI will be "used up." However, it is probable that a number of generations will pass before the majority of the world's people will be living in countries where the PQLI level is so high as to render it useless.

Correlations among PQLI, Its Component Indicators, and GNP

Does the PQLI show anything not revealed by per capita GNP? That is, do the two measures move together in a way that allows GNP to serve as a surrogate for the POLI? Similarly, does any one component of the POLI correlate so perfectly with the PQLI as to be an adequate substitute for the composite measure? In effect, is there any need for the PQLI?

The PQLI emerged partly as a device to identify non-typical or deviant performers--particularly those countries with low per capita GNP and high PQLI performances--whose experience might yield some insight into novel ways of improving life-quality results more rapidly than could be expected on the basis of typical assumptions about its relationship with GNP. For this purpose, only a perfect correlation between per capita GNP and PQLI would be enough to justify dropping the PQLI. In fact, however, the correlation between the log of 1970-75 per capita GNP and PQLI for all 150 countries implies that GNP "explains" only slightly more than half the life-quality results countries have been able to achieve, leaving the rest to be "explained" by other--institutional, historical, and structural--factors. The correlation, not all that strong overall, falls to low levels within income groups of countries (see Table 2). Figure 1 illustrates the relationship on a semi-log graph. In effect, per capita GNP is not a very good predictor of PQLI performance and cannot serve as a surrogate for it.

The other question is whether any one component is sensitive enough to reflect the behavior of the composite PQLI. The correlation coefficients of individual components with POLI and GNP and with one another are also shown in Table 2. The correlations among the three indicators are high for all 150 countries as a group. Within income classes, however, this is true only in the group of countries having per capita incomes of $2,000 or more. The data do not suggest that using only one of the indicators would adequately represent the others. The correlations between the individual indicators and the PQLI for all 150 countries together are high, but again they are somewhat lower for each of the income groups separately except the high-income group. Thus, for the developing countries, at any rate, the PQLI does provide additional information.

A final question is whether the work of Irving Kravis and others that seeks to eliminate exchange rate distortions and to re-price countries' economic activity more realistically, closer to the real purchasing power of incomes in different countries, brings their revalued per capita GNPs closer to relative PQLI values. Table 3 shows that the adjustment for purchasing power parities does result in a higher correlation between GNP and POLI

TABLE 2

Correlations[a] of PQLI with GNP, of Component Indicators with PQLI, with Per Capita GNP, and with Each Other, By Country Income Groups,[b] Early 1970s.

	Low Income	Lower Middle Income	Upper Middle Income	High Income	All Countries	All Countries
Correlations of PQLI with Per Capita GNP	.202	.126	.404	.116	.729	
Correlations of Components with PQLI Values						with per Capita GNP
LE (Life Expectancy age one)	.818	.921	.854	.974	.962	.754
IM (Infant Mortality)	-.866	-.944	-.928	-.991	-.975	-.714
L (Literacy)	.889	.906	.941	.986	.968	.680
Correlations of PQLI Components with Each Other						
LE - IM	-.586	-.819	-.768	-.964	-.919	
LE - L	.587	.776	.707	.930	.897	
IM - L	-.864	-.779	-.798	-.963	-.919	

[a] Correlation Values = R, not R^2

[b] Low Income under $300, N = 42
Lower Middle Income $300-$699, N = 38
Upper Middle Income $700-$1,999, N = 32
High Income $2,000 and over, N = 38
All Countries - N = 152

TABLE 3

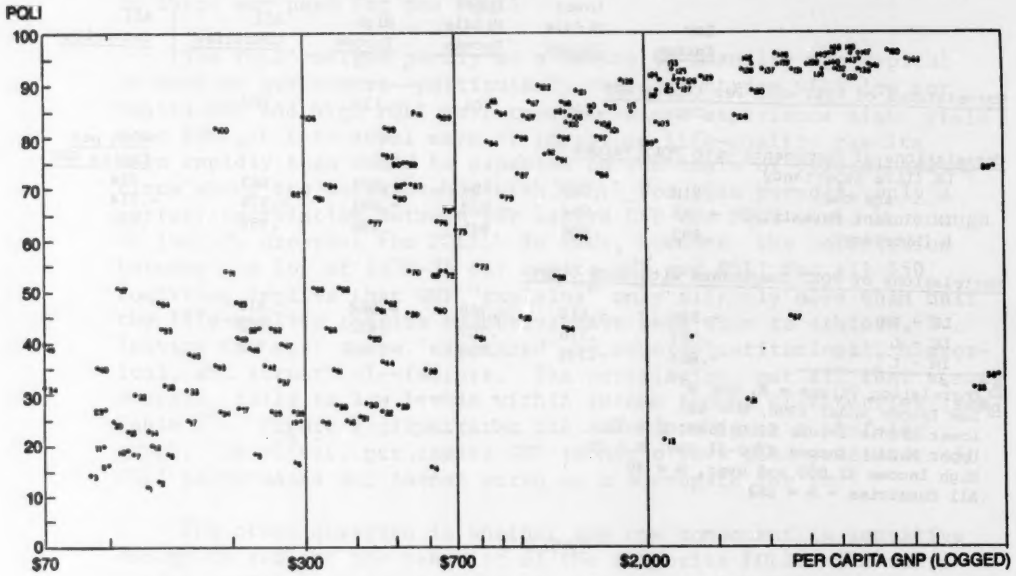
Correlation of PQLI with Per Capita GNP and with Repriced Per Capita GNP (114 Countries)

	Per capita GNP, 1970-75 average (logged)	Repriced Per capita GNP, 1970 (logged)
World (N=114)	0.79	0.84
Low-Income Countries (N=35)	0.17	0.46
Lower Middle-Income Countries (N=28)	0.24	0.10
Upper Middle-Income Countries (N=22)	0.45	0.71
High-Income Countries (N=29)	0.28	0.67

SOURCE: Per capita GNP data (1970-75 average) are from Appendix A. Repriced per capita data (1970) are from Irving B. Kravis, Alan W. Heston, and Robert Summers, "Real GDP Per Capita for More than One Hundred Countries," *The Economic Journal*, Vol. 88 (June 1978), Table 4, pp. 232-37. The 114 countries are those for which data are available in both sources. Countries are classified by income groups as in Appendix A.

FIGURE 1

Scatter Diagram Showing PQLI and Per Capita GNP (logged) Distribution, early 1970s



for all but the anomalous lower-middle-income countries. Yet there still remain substantial differences between GNP and PQLI that even re-priced GNP does not "explain." The re-pricing technique is costly and time-consuming, even when shortcuts are employed. If some combination of re-pricing and income distribution analysis should produce a high enough correlation between GNP and POLI, it might be useful to regard the PQLI as an inexpensive surrogate for adjusted GNP. However, some significant gap between the two measures will probably persist because they actually measure different things.

What the PQLI Shows

"Money is not everything." Generally, the poor countries with low per capita GNPs tend to have low PQLIs, while high-income coun-

tries tend to have high PQLIs (see Table 4). But deviations exist at all levels of income, particularly at the upper and lower ends of the per capita income range.

TABLE 4

Average Per Capita GNP and PQLI for 150 Countries, by Income Groups, early 1970s
(weighted by population)

Income Groups (Per Capita GNP)	No. of Countries	Total Population (millions)	Average Per Capita GNP ($)	POLI Average
Low-Income (under $300)	42	1,242	155	40
Lower Middle-Income ($300-$699)	38	1,081	340	67
Upper Middle-Income ($700-$1,999)	32	417	1,047	68
High-Income ($2,000 and over	38	1,040	4,404	92
All Countries	150	3,781	1,476	65

At one end of the spectrum, the oil producers of the Middle East--most particularly Saudi Arabia, Qatar, and the United Arab Emirates--and Libya, stand out with high per capita GNPs and low PQLIs (see Table 5). Of these high-income oil states, only Kuwait has a relatively high PQLI of 74. Four of the five countries have incomes equal to or above the average of all high-income countries; yet three have PQLIs below the average of the poorest countries--and Libya's PQLI is only marginally higher than that of the low-income countries. Other gross deviations in which PQLI is quite low relative to GNP include Angola, where per capita GNP is $601 and PQLI is 16, and Gabon where per capita GNP is $2,123 and PQLI is 21. Although Iran has a per capita GNP ($1,260) more than nine times larger than India ($133), its POLI is no higher.

It is clear that, as a by-product of growth in income, PQLI progress comes slowly. The rich oil states have not had their high incomes for long. However, their low PQLI results do not necessarily reflect a lack of effort. In many of these countries, considerable revenue is devoted to social services. But even the force-feeding of social overhead improvements does not yield immediate results. Along with larger per capita incomes and social

will, there is also need for time--time to design appropriate institutional systems and to integrate appropriate social and individual behaviors.

TABLE 5

Five High-Income Countries with Low PQLIs, early 1970s

	Per Capita GNP ($)	PQLI
All High-Income Countries (average)	4,404	92
Kuwait	13,787	74
Libya	4,402	45
Qatar	11,779	31
Saudi Arabia	3,529	29
United Arab Emirates	14,368	34
All Low-Income Countries (average)	155	40

At the other end of the spectrum, six countries with per capita incomes still under $700 have already achieved a PQLI of 77 (Table 6). Eight additional countries with per capita incomes below $700 have ratings of 68 or more. Table 6 shows that the results measured by the PQLI do not flow from development choices that are made only by a particular type of economic-political system. Cuba, the Republic of Korea, Sri Lanka, and (before their rapid rises in per capita GNP) Costa Rica, Hong Kong, and Taiwan--with very different political systems--all achieved PQLIs in the mid-80s at per capita GNP levels below $700. Other countries with equally varied systems--China, the Philippines, Colombia, and others--have been able to attain PQLI levels that are only slightly less satisfactory. Sri Lanka and the Indian state of Kerala, where extremely low per capita GNPs are associated with quite high PQLI ratings, are the most striking examples.

At the moment, understanding of how and why these favorable aberrations have come about is limited. Some countries, whether by design or by force of circumstances, have employed policies that have been unusual in their effects. The particular strategies that have produced these results may offer insights on how to improve life chances more rapidly than has been possible with orthodox development policies. For example, if the POLI of countries having per capita GNPs of $700 or more and PQLIs below 68 could be raised to 68, over 143 million people would be affected. If countries having per capita

TABLE 6

Low- and Lower- Middle-Income Countries with High PQLIs.

	Per Capita GNP ($)	PQLI
All Low-Income Countries (average)	155	40
Sri Lanka	179	82
Kerala State, India[1]	126	68
All Lower-Middle-Income Countries (average)	340	67
PQLI of 77 or over		
Cuba	640	84
Grenada	465	77
Guyana	559	85
Korea, Republic of	464	82
Western Samoa	300	84
PQLI of 68-75		
Albania	530	75
China, People's Rep.	300	69
Colombia	526	71
Ecuador	505	68
Mauritius	552	71
Paraguay	533	75
Philippines	342	71
Thailand	318	68

NOTE: Three additional countries--Costa Rica, Hong Kong, and Taiwan --presently with incomes higher than $700 achieved POLIs of 77 or more in the early 1960s, when their per capita incomes were still below $700.

[1]While the Indian state of Kerala is not an independent country, it is included not only because fairly good data are available, but also because of its anomolously high PQLI (in comparison with the all-India average of 43) and low per capita income (India's per capita income is $133). Moreover, its population of 21 million makes it larger than many countries. Kerala's PQLI is based on an infant mortality rate of 58 deaths per thousand live births, a life expectancy at age one of 66.4 years and a literacy rate of 60 percent (corresponding Indian figures are 122, 56 and 34).

incomes of more than $179 could duplicate Sri Lanka's experience, 1.6 billion people would be affected.

Country clusters. Countries are not randomly scattered; there tends to be some clustering of PQLI values. Of the forty-three countries with the lowest PQLIs of 36 or less, all but ten are African. Of these ten, five--the Yemen Arab Republic, the People's Republic of Yemen, Saudi Arabia, Qatar, and the United Arab Emirates--are Arab; three--Afghanistan, Nepal, and Bangladesh--are South Asian; the other two countries are Haiti and Laos. On average, the African countries individually and collectively tend to rank substantially higher on a per capita GNP scale than on a PQLI scale.

Although emphasis is often put on Latin America's poverty and its gross maldistribution of income, it has clearly reached a higher level of PQLI performance than the African countries. Latin American countries generally also perform substantially better than South and Southeast Asian countries. With the exception of Haiti (with a PQLI of 36), Bolivia (43), and Honduras (51), no Latin American country has a PQLI as low as the highest state in Africa (South Africa, 53). While no Latin American country has reached a PQLI of 90 equivalent to the European values, the Latin American average of 71 is comparable to the East Asian average of 73. The world average PQLI weighted by national populations is 65.

South Asia, with a PQLI average of 41, seems to have its own pattern which, even though Afghanistan (18) and Nepal (25) are included, still is well above the African average of 32. On the other hand, it is below the average for Southeast Asia (55). When disaggregated, Southeast Asia seems to have three groupings: Kampuchea and Laos, with very low PQLIs; Indonesia, Vietnam, and Burma, with PQLIs close to the regional average; and Malaysia, Thailand, the Philippines, and Singapore, with PQLIs well above the average. There are other visible clusterings; one of these is found in the Caribbean; with the exception of Haiti (36) and the Dominican Republic (64), the other Caribbean islands all have PQLIs in or near the 80s.

Development discussions often imply that all poverty is of much the same sort and can be confronted in much the same way. Differences in the nature and scope of poverty often are attributed to resource differences, technical differences, and narrowly defined economic differences. They may to some extent be defined by continent--there are African, Asian, and Latin American poverty problems. But physical geography is not the decisive element. The clustering seems to express similar forms of social organization and historical experience that are relevant to a nation's capacity to deliver inputs which contribute to PQLI results. Detailed explanations are not possible without much more research and analysis; but it does seem apparent that

the problems confronting black African states as a group (and probably also Afghanistan, some of the Arab states, and others) in trying to raise their PQLIs are probably quite different from those that confront South Asian, Southeast Asian, or North African countries as a group, or Latin American countries as another group. Thus specific attention should be paid to these institutional differences and to their policy implications.

Distribution of benefits. The PQLI's components express distributional characteristics. Changes in literacy, infant mortality, and life expectancy at age one reflect changes in the availability of these benefits to the whole population. Overall the PQLI is a much simpler measure of benefit distribution than those that try to measure the distribution of national incomes.

The World Bank has compiled income distribution figures for sixty-six countries, measuring inequality by the share of income going to the poorest 40 percent of households. The smaller the share going to this group, the more unequal income distribution was said to be. The Bank's income distribution measure and the PQLI do not appear to correlate well. There seems to be no correlation between income equality and PQLI. The PQLI captures the total effect of social and economic policy as well as results of the way private income is spent. These welfare results cannot be predicted from income distribution data any better than from average income levels.

Special Purpose PQLIs

Because literacy, infant mortality, and life expectancy data presently are not available by income classes within countries, it is not possible to construct a PQLI to compare them. PQLIs can, however, be constructed for other intra-country categories that, in turn, can yield significant information about the distribution process. PQLIs describing differences among ethnic groups (where they are tabulated by data collectors), among sub-national geographical regions, between females and males, and between rural and urban sectors can be constructed.

Male and female PQLIs. Of the seventy-three countries for which data--of varying quality--are available on sex differences, there are twenty-eight in which the female PQLI was lower than the male PQLI in one or more years between 1949 and 1972; eighteen had differences of more than three points ranging from 4 to 11. The list includes countries at various levels of income and PQLI; they do not seem to be concentrated in any culture area.

Female literacy rates are lower in sixty-six of the seventy-three countries. The most extreme case is Burma with a difference of 49 points in 1955. On the other hand, female performance in in-

fant mortality and life expectancy at age one is typically better than male performance. India (1970) is the only country for which all three indicators registered worse performance for women than for men. The evidence suggests that, both where infant mortality rates are very high and where they are extremely low, females generally have higher survival rates. Similarly, women seem to have longer average life spans and, as average life expectancy rises, the gap between females and males seems to widen. In countries with the longest average life expectancies, there currently is a difference of six to eight years between the life expectancies of men and those of women. For the purpose of making most development policy, such differences may not matter, since the basic task if to raise the average PQLI for both sexes. But where policy is focused on the condition of women, it may be desirable to develop separate PQLIs.

Rural and Urban PQLIs. Rural-urban comparisons are more difficult to make. Generating such data is a task that has long frustrated demographers. Thus far rural-urban PQLI data are available for only three developing countries (see Table 7).

TABLE 7

Rural and Urban PQLIs for Three Countries, early 1970s

	Rural	Urban	% Urban Superiority
Ghana	28	54	93
Indonesia	45	61	36
Liberia	27	42	56

The gross superiority of urban PQLIs shown in the three developing countries is somewhat surprising. Development literature and policies have stressed the great influx of people into urban areas and the consequent strains on previously inadequate social infrastructure. The high population densities, the gross poverty of large groups of people, and inadequate public facilities would lead one to expect worse conditions in the city than in the countryside. These limited data suggest that--in spite of fairly widespread ideas about the horrors of urban existence in less developed countries--the developing-country towns seem to offer people better physical life chances of the kind measured by the POLI than exist in the countryside.

Conclusions

The Physical Quality of Life Index promises to serve as a creative complement to the GNP. By focusing on results rather than

inputs, it records how widely certain basic characteristics are distributed within and among populations. It informs about the changing distribution of social benefits among countries and, within a country, between the sexes, among ethnic groups, and by region and sector. By minimizing the developmental and cultural ethnocentricities that bedevil most other measures, the PQLI facilitates international and regional comparisons. Because it is bounded at the upper end, the PQLI can be used to set objectives that are achieveable. As countries move slowly or less slowly toward closing the gap between their current performance and that presently considered to be the maximum attainable performance, the gap between "rich" and "poor" countries can be expected to narrow.

The PQLI disparities among countries can be understood in a way that disparities in per capita GNP sometimes are not. Knowing that, in absolute terms, world poverty is so extreme that in 1969 about half the combined populations of Latin America, Africa, and Asia (excluding China) lived with average per capita incomes below $75 (in 1971 prices) is not very meaningful, especially when, in most of these countries, life expectancies are increasing and infant mortality rates are declining at the same time. The numbers obviously do not mean that these people are living for a year on what a person in the United States could buy with $75. Yet if they are used merely to note that there are a great many poor in the world, they may in fact do more harm than good. Such well-intentioned but shrill and unqualified presentations tend to discourage, rather than to elicit, remedial action.

The PQLI, in contrast, does not create the picture of a hopeless race. In fact, it avoids the necessity of thinking about national development as a race at all. It places a country on a meaningful scale in relation to specific and fixed objectives, and records over time its performance toward meeting those objectives.

[Extracted from Measuring the Condition of the World's Poor, The Physical Quality of Life Index, Chapters 1, 4, 5, 6. Published by the Pergamon Press Ltd., Oxford, England, for the Overseas Development Council, Washington, D.C.]

The Social Accounting Matrix

Graham Pyatt and Erik Thorbecke

[In order to plan policies in which the objectives of growth and equity for the poor are considered, and to estimate what the results of various policy combinations will be, an integrated framework is needed. This article describes how a framework for this and related purposes can be constructed, and the required data identified.]

A major research project is underway on planning for growth, redistribution and employment, in an attempt to understand how the interaction of different forces within a developing economy determines its progress. The main emphasis is on the links between growth, inequality and employment, and not least on how the extent of poverty and changes in it are related to familiar issues of savings and investment, balance of payments, production and distribution. The approach to these questions is basically that of the economic planner. In this survey of the main research project we present some of the major elements of the proposed framework to show its operational usefulness in policy formulation. While the work is mainly technical, its context is one of practical and urgent development problems, and the need to identify policies capable of resolving these problems. A comprehensive planning framework and data system are built in order that the way in which the living standards of different groups within society are determined and the roles they play in the process of economic development may be perceived. From this we try to obtain a better appreciation of those forces which create a dynamic for growth, and those which leave behind, in poverty, substantial fractions of the population.

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We begin by stating that what interests us most is the living standards of different groups within a society. An initial problem, therefore, has been to examine the possibility of measuring living standards and to set these measures in a comprehensive empirical framework and data system which shows numerically what is going on in any economy, and how the living standards of different groups are related both to each other and to other aspects of economic activity. The United Nations System of National Accounts does not do this. One of our main recommendations is that work on national data systems can and should be reorganized so that planning can be concerned with poverty and inequality as well as with growth. An important part of our work is concerned with suggesting appropriate classification schemes, and placing the relevant facts on a consistent basis to measure and analyze jointly the determinants of growth, income distribution and employment. Clearly, the prevailing informational systems used by policy makers could be greatly improved in this respect.

Data systems do not exist independently of a conceptual framework. The reason why national income statistics do not contain an integrated statement of living standards for different groups is that distributional questions are not part of the conceptual framework which underlies them. That framework is preoccupied with growth: therefore, separate statistics on income distribution imply a conceptual framework which regards inequality as a separate issue, and a more equal distribution of income as a policy objective in its own right. Our concern to bring the two sets of data together in an integrated whole reflects the fact that their inter-relationship is essential. The crux of the problems facing many developing countries concerns the potential conflicts between policies to encourage growth and those which will do something in the short term to ameliorate the lot of the poorest members of society. If these conflicts are to be understood we need a conceptual framework which embraces them simultaneously and focuses on the links between them, both actual and potential. A general data framework is then needed to serve the conceptual framework, and not as an end in itself.

A conceptual framework which brings together growth and inequality in a comprehensive way is the main theme of this research. The framework itself is modular, consisting of a set of inter-related subsystems. [A module is an interchangeable unit that can be used in construction of a building in which a number of different modules function together.] Since it incorporates a large set of policy measures, the alternative effects of different development strategies --i.e. different packages of policy measures--on growth, equity and employment can be analyzed quantitatively.

Our comprehensive planning framework is built upon two pillars: (a) a modular analytical framework specifying, for a set of inter-

connected subsystems, the major relationships between variables within and between these subsystems; and (b) an elaborate complementary data and classification system. These two pillars can be combined together into a social accounting matrix (SAM), containing not only the comprehensive data system for any given period but the whole algebraic specification of the dynamic model linking the various variables and subsystems and permitting the derivation of future equilibrium values and, consequently, future SAMs.

As a data framework, the social accounting matrix is a snapshot at one particular moment. It provides a classification scheme for data which is useful in the light of policy needs and available to the planners. The SAM framework also incorporates explicitly various crucial transformations between variables, such as the mapping of factorial income distribution from the structure of production, and the mapping of the household income distribution from the factorial income distribution.

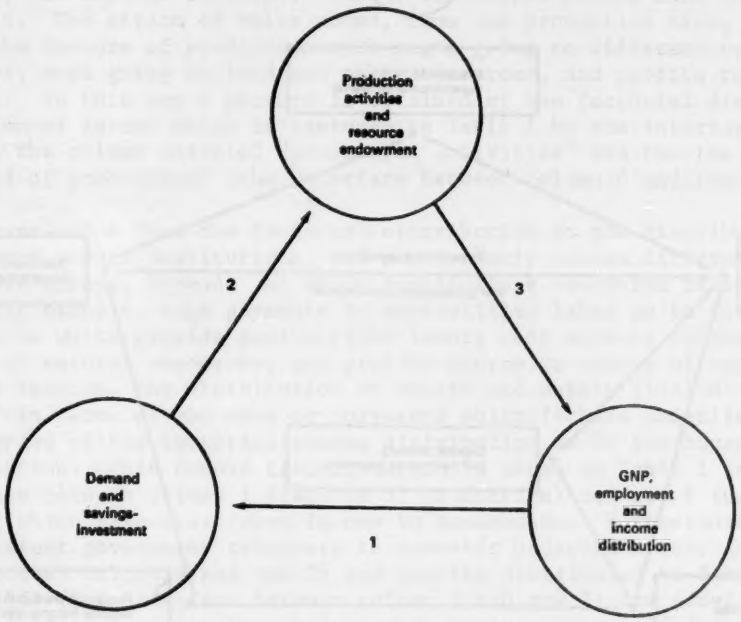
The Conceptual Planning Framework

Perhaps the simplest starting point in describing our framework as an analytical system is to recall the inter-relationship between (a) the structure of production; (b) the distribution of the value added generated by the production activities; and (c) consumption, savings and investment. Figure 1 reflects this interrelationship in terms of the three links. Such a system should be internally consistent, in both a static and a dynamic sense. The static requirements are that, starting at any point in the triangle, the feedback mechanism throughout the system should yield the same initial set of values. For instance, if the starting point is a given pattern of income distribution and employment, corresponding expenditure and investment effects are implied by link 1 in the diagram. In turn, this implies a given output mix through link 2, which then translates via link 3 into a derived demand for factors, and corresponding household income distribution equivalent to the one which was initially selected. The last distribution must be the same as the distribution assumed initially.

The logic underlying our modular planning framework and its corresponding data system is more complex than the triangular scheme presented in Figure 1. The major module of that framework, as well as the causal interdependence between the former, is given in Figure 2. This diagram is a simplified subset of the complete system which is shown below in Figure 3 and discussed in detail. (Figure 2 emphasizes those parts and relationships of Figure 3 which are drawn in double lines in the latter.)

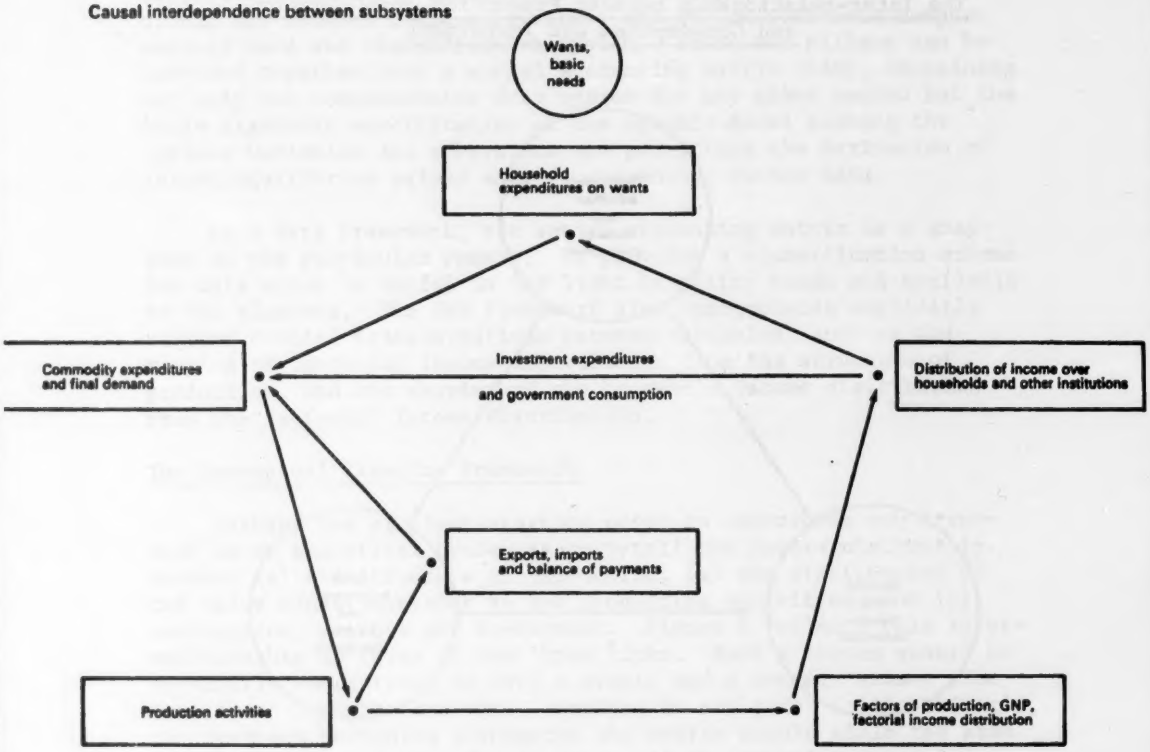
FIGURE 1

The Inter-relationship between Production, Distribution and Consumption and Investment



Since our conception of economic and social development is the attainment of higher standards of living for all, but particularly for the poor members of society, the logical starting point is a recognition that households have basic needs and wants which can be satisfied through the purchase of a bundle of commodities. In turn, the total effective demand for the set of commodities desired is met by the output of the whole constellation of production activities. The next loop in the circular flow in Figure 2 consists of the derived demand for the factors of production generated by the production activities which yield the factorial income (value added) distribution and GNP. Finally, the factorial income distribution can be mapped into a distribution of income over households and other institutions (i.e. government and companies) which completes the interdependent system by providing the means of satisfying household and government wants, as well as investment requirements, thus bringing us back to our initial point.

FIGURE 2



Conceptually, it is through the production process that value added accruing to the various factors of production is generated. In turn, value added received by the factors, complemented by and corrected for transfer payments, taxes and subsidies, has to be mapped into a corresponding household income distribution. Thus, three levels or steps can be distinguished in this mapping process: (a) the structure of production, typically broken down into a number of production sectors or activities; (b) the factorial distribution of value added; and (c) the household distribution of income. In the process of mapping the household income distribution from the streams of value added generated by the production activities, a crucial question is that of an appropriate classification scheme for the various accounts in the SAM. If the transformation from the structure of production to the factorial, and ultimately the household, income distribution is to be performed in an operationally useful way for planning purposes, great care must be exercised in designing appropriate classification schemes for each account.

Thus our data system incorporates--what national income accounts ignore--the mechanisms that translate the generation of value added by production into the income of different types of households and other institutions. The link is provided by factors of production. The level and structure of output by the different activities generate the aggregate demand for labor of different types, natural resources, and capital services. Hence, employment enters into the analysis. The stream of value added, from the production side, rewards the factors of production with wages going to different types of labor, rent going to land and other resources, and profits to capital. In this way a picture is obtained of the factorial distribution of income which is captured in Table 1 by the interface between the column entitled "production activities" and the row "factors of production" (the interface between column 6 and row 1).

Translation from the factorial distribution to the distribution of incomes across institutions, and particularly across different household groups, depends on which institutions own which factors. Thus, for example, wage payments to semi-skilled labor go to the households which provide semi-skilled labor; rent accrues to the owners of natural resources; and profits accrue to owners of capital. In this fashion, the distribution of wealth and assets (including skills) in terms of who owns or possesses which factors underlies the mapping of the factorial income distribution on to the household distribution. This second transformation is shown in Table 1 in the interface between column 1 (factors of production) and row 2 (households), which allocates labor income to households. Furthermore, when current government transfers to domestic households (the interface between column 4 and row 2) and profits distributed to domestic households (the interface between column 3 and row 2) are added to the labor income of the households, the complete household income distribution is obtained. It follows that the latter can be changed either (a) by altering the factorial distribution; (b) by changing the distribution of wealth in terms of factor ownership; or (c) through a different pattern of transfer payments.

There are two further considerations which our accounting framework must embrace. First, the existence of wealth implies accumulation, and hence savings to finance it. Savings also provide a difference between income and consumption for different groups in the population. It is important, therefore, to include capital accounts in our framework, to note the amount of savings available to finance investment--who saves, and who invests. At the same time we want to dissect the commodity composition of consumption so that living standard comparisons can be made. Finally, our accounts must cover relations with the rest of the world in terms of merchandise trade, international factor and non-factor payments, international capital movements and foreign aid.

TABLE 1

A basic social accounting matrix (SAM)

Receipts				Expenditures: 1	2	3	4	5	6	7	
					Institutions						
				Factors of production	Current accounts			Combined capital account	Production activities	Rest of the world combined account	Totals
					Households	Companies	Government				
	1	Factors of production							Value added payments to factors	Net factor income received from abroad	Incomes of the domestic factors of production
	2	Institutions: Current accounts	Households	Allocation of labour income to households	Current transfers between households	Profits distributed to domestic households	Current transfers to domestic households			Net non-factor incomes received from abroad	Incomes of the domestic institutions after transfers
	3		Companies	Allocation of operating surplus to companies			Current transfers to domestic companies				
	4		Government		Direct taxes on income and indirect taxes on current expenditure	Direct taxes on companies plus operating surplus of state enterprise		Indirect taxes on capital goods	Indirect taxes on inputs	Net non-factor incomes received plus indirect taxes on exports	
	5	Combined capital account			Household savings	Undistributed profits after tax	Government current account surplus			Net capital received from abroad	Aggregate savings
	6	Production activities			Household consumption expenditure on domestic goods		Government current expenditure	Investment expenditure on domestic goods	Raw material purchases of domestic goods	Exports	Aggregate demand = gross outputs
	7	Rest of the world combined account			Household consumption expenditure on imported goods			Imports of capital goods	Imports of raw materials		Imports
		Totals		Incomes of the domestic factors of production	Total outlay of households	Total outlay of companies	Total outlay of government	Aggregate investment	Total costs	Total foreign exchange receipts	

Table 2 shows in a more consolidated form than the previous table the mapping from the structure of production to the distribution of income. (Table 4 below represents an application of the format of Table 2 to the data from Sri Lanka.) Table 2 is built around a central aggregate, the total income of the domestic factors of production. In the northeast quadrant (i.e. the upper right portion of the diagram) we have the details of how this depends on the structure of production and factor markets. In the northwest quadrant this total income is allocated to the institutions, and particularly the households, which provide the factor services. Hence, the distribution of wealth--defined to include human skills as well as capital--underlies this northwest quadrant. In the southwest quadrant the effects of transfer payments, i.e. of profit distribution, taxation and government social security payments, are shown. As a result of these last transactions, the central aggregate is decomposed into the disposable income of the institutions including the households.

Tables 2 and 4 are useful in revealing the determinants of the income distribution. A first determinant is the structure of production and factor markets, including labor markets. Next there is the distribution of wealth, defined to include human skills; and finally the fiscal system of taxation and benefits. All three are basic elements, and any policy to influence the distribution of income needs to focus on all three of these areas.

TABLE 2

Tableau for the Analysis of Income Distribution

		Institutions current accounts			Total	Production activities	Rest of the world
		Households	Companies	Government			
Factors of production	Labour	Allocation of labour income to households			Factorial distribution of income	Wages	Net factor incomes received from abroad
	Other	Allocation of surplus of unincorporated enterprises	Allocation of operating surpluses to companies			Operating surpluses	
Totals		Distribution of factorial income over institutions before transfers				Value added	Net factor incomes received from abroad
Institutions current accounts	Households		Profits distributed to domestic households	Actual and imputed current transfers to households	Distribution of disposable income		
	Companies			Current transfers to domestic companies			
	Government	Direct taxes on income	Direct taxes on companies plus operating surpluses of state enterprises				
Rest of the world		Net non-factor incomes paid abroad			Net non-factor incomes paid abroad		

Distribution of factorial incomes over institutions minus total transfer payments

* = Aggregate income of the domestic factors of production.

It is important to remember, however, that in reality the structure of production and income distribution are inter-related through the interdependent system represented in Figure 1. It is this causal interdependence which accounts for the substantial element of simultaneity that exists in the determination of the output and incomes. It is therefore not easy to change income distribution, since its determinants are to a considerable extent woven into the structure of an economy and cannot easily be disentangled. This is a recurring theme in the analysis and an important point of emphasis for perception of the issues.

Towards an Integration of the Conceptual Planning Framework and the Data System

At this stage it is important to integrate more formally the conceptual framework and the data system we have just discussed into a comprehensive social accounting matrix. Figure 3 sets out the comprehensive conceptual economic framework, and serves as an organizing scheme for subsequent analysis. It is, as noted above, an extension of Figure 2. The arrows linking different parts of the system reflect causal connections. The relationships are discussed individually, or grouped into subsystems in our main research, and are to be considered as modules in a more complete system. This modular approach has certain advantages: it implies that the complex of interactions in Figure 3 can be discussed separately, module by module.

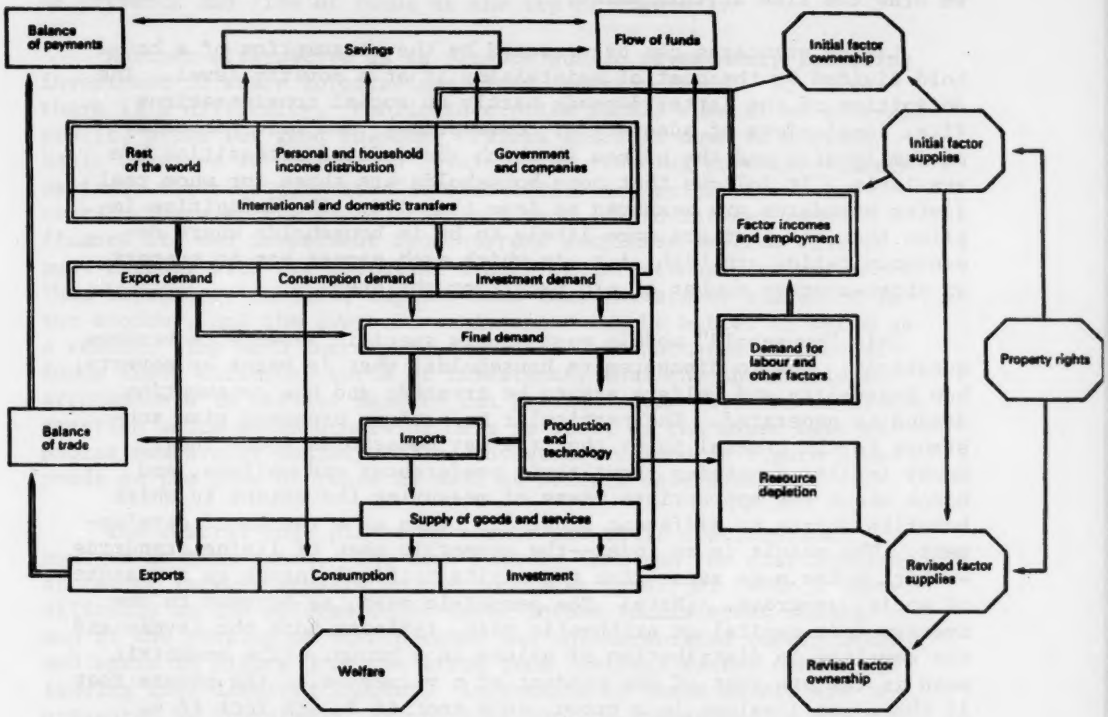
The major modules presented below are: (a) households and living standards; (b) savings, investment and the flow of funds subsystems; (c) final demand and its link with production; and (d) the structure of production and asset ownership and its relationship to income distribution and employment. It should be noted that Figure 3 depicts an interactive system of mostly simultaneous relationships. Given our concern for the living standards of different socioeconomic groups, we begin with module (a).

Households and their living standards. Conventional treatments which subdivide households by income level are not very helpful for a number of reasons. Policies have to be directed to particular groups which are identifiable directly in policy terms, and this usually means production categories. Examples are semi-skilled industrial workers, landless rural labor, workers in the informal urban sector, and rentiers. Policies can be formulated according to their impact on such groups. By contrast, individuals who earn between a quarter and a half of the average level of income are hard to legislate for as such. It follows that an operational approach must be based on a socioeconomic classification distinguishing identifiable (and relatively homogeneous) groups which can be reached by policy means. In its simplest form such a classification could be analogous to that distinguishing between urban, rural and estate households in Sri Lanka (see Table 4). In general, however, it is desirable to specify a more thorough and disaggregated classification.

In our approach we suggest that there are three main criteria on which a household classification should be based: (a) location; (b) sociological considerations; and (c) wealth. Location is justified on the grounds that policy often has a locational element and that the regional fragmentation of job opportunities, for example,

FIGURE 3

The Modular Conceptual Framework



can be important. The sociological factors which may be relevant are race, religion and language. These may be the basis of market fragmentations or other forms of discrimination. Ethnic groups comprise a significant fraction of the poor, especially in Latin America. Otherwise such factors matter because of differences in consumption habits, for example, or participation in different lines of production. Wealth is important at several levels. Access to land is a critical consideration in rural areas, and the landless can be affected quite differently from the smallholder by development policies. The truly rich are similarly quite distinct, and their role in the process of savings and investment calls for special consideration. They stand to lose by redistributive policies which are not underpinned by significant growth. Their behavior and incentives are therefore potentially critical.

Having defined classification criteria for household groups, we argue that the main concern should be with the average level of living standards in each group. This averaging implies that variations within groups do not receive much attention, even though an average may conceal a considerable range of variation. However, there is a limit to the amount of detail that can be sustained, and we draw the line at this point.

Living standards can be measured by the consumption of a household divided by the cost of maintaining it at a poverty level. The definition of the latter depends partly on social considerations (i.e. local views of adequacy of consumption), and more generally on family size and the prices at which the defined necessities are available. It follows that poor households are those for whom real living standards are measured as less than 1.0. The definition implies that the poor are more likely to be in households where dependency ratios are high, i.e. in which each earner has to support an above-average number of old people or children.

This "household" module must supply specific answers to various questions: how to disaggregate households; what is meant by poverty; how inequality and welfare are to be treated; and how consumption demand is generated. The particular mechanisms proposed give substance to the general point that the way households spend their money implies something about their preferences and welfare, and hence about the appropriate means of measuring the extent to which benefits accrue to different household types as a result of development. The result is an index--the geometric mean of living standards --which makes more sense than per capita national income as a measure of social progress. [Note: The geometric mean, as opposed to the average (per capita) or arithmetic mean, reflects both the levels and the equality in distribution of values in a group. (The geometric mean is the nth root of the product of n values--e.g. the square root if there are 2 values in a group, cube root if 3, 4th root if 4, etc.) In a simple example: two villages have 2 people and the same average income. In village A incomes are 9 and 2, in B they are 5 and 6; $11 \div 2 = 5.5$. But in A $9 \times 2 = 18$ and $\sqrt{18} = 4.24$; in B $5 \times 6 = 30$ and $\sqrt{30} = 5.48$.]

Savings, investment and the flow of funds. Considerations regarding the relationship between savings and investment are important for our analysis. We are doubtful about the evidence which suggests that greater equality reduces personal savings. But such changes in income distribution will alter the pattern of who saves, and hence who invests at the household level. Similarly, any change in profit levels will most probably alter the investment of private companies. In these respects, therefore, inequality and economic growth are intimately connected. Profits must be available to finance invest-

ment if private domestic companies are to play a leading role in growth. But there are alternatives, among them private investment from overseas (which brings in expertise also), and foreign aid to finance public investment. Both operate through international capital transactions and in part explain the link between balance of payments and flow of funds at the top of Figure 3.

Another alternative is to finance public investment, including investment in state corporations, from domestic funds. But here there is a difficulty. Public enterprise rarely runs at an over-all profit, often for good reasons. Prices are held down to provide basic services at subsidized levels, thus reducing poverty. Externalities might be generated so that efficiency prices are below costs. Whatever the cause, the fact that government can rarely finance its own investment from current surpluses implies that it must borrow, with the potential danger of inflationary consequences. This borrowing, in turn, implies less real investment elsewhere in the economy, and the over-all achievement may be better or worse as a result. The main concern is that different patterns of flow of funds imply different sorts of investment, that the institutional arrangements in capital markets can preclude some patterns of credit creation which would otherwise help to build up the asset base of poorer members of society. Thus investment demand in Figure 3 depends on the flow of funds as well as being a determinant of it.

The central role played by assets and their distribution emerges at this point. The link between them and the distribution of factor incomes appears in the northwest corner of Table 2 (specifically as the allocation of labor income to different skills, and of the surplus of incorporated and unincorporated enterprises), and again in Figure 3 as the arrow from "initial factor ownership" leading into domestic incomes. Increments to these assets are represented by investment, in which we include investment in human skills through training and education, as well as factories, offices and roads. If, therefore, income distribution is to be changed through encouraging asset accumulation by the poorest at above-average rates, either the poorest must be provided with credit or they must be able to finance investment from their own savings. If the latter were possible it is unlikely they would be so poor. The former may require new institutions and a diversion of resources from other investment opportunities. Power politics may preclude this. If not, the question remains whether investments which provide assets for the poor will generate as many social benefits as could be derived from other investment opportunities which have to be forgone. It is this potential conflict which can lead to trade-offs between growth and reduced inequality. Equally, some strategies may be conducive to both.

Final demand and its link with production. Consumption, investment and export demands make up the final demands on production activities and hence determine levels of output and imports. Most development planning models make strong assumptions regarding the above relationship. Our concern has been to set out a more flexible treatment which allows the link between final demand and output to be handled with greater sensitivity.

The first point to make is that prices are determined endogenously within the general framework, rather than being specified separately in advance. For some goods demand is very insensitive to price (price-inelastic) - for example, recent rises in oil prices and in prices of manufactured goods did not result in dramatic falls in quantities imported but in large balance of trade deficits. For other goods demand is highly elastic, so that relatively small changes in price will radically alter the quantities purchased. By allowing imports to be sensitive to prices in varying degrees, our approach makes it possible to explore how tariffs and quotas influence the economy, and to ascertain the optimal exchange rate policy to adopt. This may seem a long way from questions of poverty and inequality; but if production is restricted for lack of spare parts or raw materials, employment must drop. Lack of foreign exchange may mean food shortages when countries are not self-sufficient, and the general restriction on both production and incomes which follows from a balance of payments constraint may be the reason why output has to be sacrificed to obtain more jobs.

The extent to which an economy relies on imports depends on the structure of demand relative to production, i.e. on how much import substitution has already taken place and the scope for further developments along these lines. The latter depends in turn on the resource base of the economy and, more generally, on its comparative advantage in trade with others. To answer such questions it is essential to know how prices are determined within the economy.

Since prices are determined within our analytical framework, the design of fiscal policy can be explored. Such policy instruments as direct and indirect taxes, export subsidies and public utility pricing policy all improve or impair the performance of the economy relative to its objectives. We have not undertaken a specific country study to evaluate these issues, but it seems that at some point the poorest of the poor can be helped only by fiscal transfers. The relevant questions then would be how transfer policies should be designed for maximum effect, and what their costs are in other respects.

Another aspect of our treatment of the way in which demand translates into production is that it reveals where capacity is

short. This is important for recognizing the investment opportunities in an economy--the lines of activity which might be expanded and the new activities which might be started. Alternative plans can consequently be evaluated on the basis of shortages in current production capacities.

The structure of production and resource ownership and their relationship with income distribution and employment. The analysis has now covered all but the links on the right-hand side of Figure 3. The detailed discussion has built up from the distribution of income to the structure of production, and included both balance of payments and flow of funds considerations. This involves some extensions of traditional methods. The outstanding issues are less often discussed in a planning context. They include employment and wealth.

The details of the approach to labor markets which we adopt are not presented here. Their outcome is a formulation which recognizes four important points. First, equilibrium in labor markets can be brought about through (a) adjustment of unemployment and underemployment rates in the typical case of excess supplies; (b) adjustments in output when, for example, key skills are scarce; and (c) adjustments in wage rates. The last of these three is an alternative to the first two. Our view is that in practice it plays a role only in the long term. Second, the formulation recognizes the importance of both education and experience in determining job opportunities and earnings. This corresponds to observed statistical relations which find these variables to be important. Third, a basis for migration is derived from the analysis which corresponds with the observed phenomenon whereby educated young males are found to be more successful than others in obtaining work subsequent to a move. And finally, the formulation yields ways of evaluating the prospective benefits to people from being better fed and better educated in terms of their expected earnings ability. Thus many of the important issues in labor market analysis are tackled, if not resolved.

Returning now to Figure 3, it can be seen that the interaction of demand for factors and available supplies generates the factorial income distribution and the pattern of employment, which represent major determinants of the distribution of household and personal income. This link corresponds to the northeast quadrant of Table 2, while the question of who owns the various factors underlies the northwest quadrant. Thus the modules are complete when we have specified the determinants of profits (or operating surplus) for each of the production activities--a question to which we now turn.

There is no easy answer to the question of what determines profits, and our approach allows for the interplay of various forces.

Our starting point is prices, since the question can be translated into the mark-up of costs which is used to determine selling price. At least three factors are important here. The first is the degree of competition. In traditional activities this is usually high, since there is freedom of entry and a potentially large number of producers. In modern sector activities there may be little competition because of state monopolies, markets limited in size, or protective barriers against foreign competition. A second important factor is the speed at which production activities operate. Experience in using new techniques usually leads to increasing efficiency over time. This implies that production lags are shorter, and hence that working capital can be reduced. Over time, therefore, the share of profits can be expected to fall for this reason. Finally, profit shares are likely to depend on the attitudes of entrepreneurs. If they require large expected returns to investment, increases in demand are more likely to spill over into imports than to elicit a domestic supply response in terms of increased capacity. Accordingly the share of profits depends on the responsiveness of entrepreneurs to investment opportunities. If they are reluctant to invest, increases in domestic demand result in higher prices, increased imports, or both. Conversely, an animated entrepreneurial class can translate increasing demand into economic growth.

Once investment is determined the system is complete, since investment minus resource depletion generates future factor endowments, which provide the initial conditions for subsequent period analysis. At this point, therefore, we need to consider how the various modules are formally integrated into the over-all framework.

The Formal Incorporation of the Modular Framework into a Social Accounting Matrix (SAM)

The modules and their corresponding classification systems in Figure 3 can be translated into the social accounting matrix presented in Table 3. This table is an extension of the matrix presented in Table 1. The new elements, such as the detailed treatment of capital accounts to reflect the initial as well as the revised wealth held as factors of production (which were described in the modules of the preceding section), are incorporated into the new SAM. In fact, Table 3 is the informational counterpart of the modular system we have just discussed. Before we proceed, it should be recognized that empirical work today has not progressed very far beyond the quantification of the basic SAM shown in Table 1 and in Table 4 for Sri Lanka.

Table 3 involves 14 symmetrical rows and columns. (An additional fifteenth row is defined on a net basis and therefore does not spoil the over-all balance.) Since each row (and the corresponding

TABLE 3

Final SAM Schema (Including Commodity Accounts)

Receipts				Expenditures														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	
				Current accounts					Capital accounts						Current accounts			
				Wants	Factors of production	Domestic institutions: Households	Domestic institutions: Companies	Domestic institutions: Government	Domestic institutions: Households	Domestic institutions: Companies	Domestic institutions: Government	Domestic factor endowments	Financial claims	Rest of the world	Rest of the world net excl. imports	Production activities	Commodities	Totals
Current accounts	1		Wants			Want satisfactions												Demand for want and need satisfactions
	2		Factors of production												*Net factor incomes received from abroad*	Value added payments to factors		Incomes of domestic factors of production
	3	Domestic Institutions	Households		Allocation of labour income to households		Profits distributed to domestic households	*Current actual and imputed transfers to h'holds*										
	4		Companies		Allocation of operating surpluses to companies			*Current transfers to domestic companies*							*Net non-factor incomes received from abroad*			Incomes of the domestic institutions after transfers
	5		Government			*Direct taxes rates*	*Company tax rates*											
Capital accounts	6	Domestic institutions	Households			Household savings						*Initial wealth held as factors of production*	*Initial wealth held as financial claims*					
	7		Companies				Undistributed profits after tax											Revised wealth of the domestic institutions
	8		Government					Government current account surplus										
	9		Domestic factor endowments						Revised wealth held as factors of production									Revised factor endowments
Capital a.	10		Financial claims						Revised wealth as financial claims				Flow of funds	Revised foreign claims on domestic institutions				Revised financial claims
	11		Rest of the world										*Initial foreign claims on domestic insts.*		Balance of payments current account deficit			Revised foreign claims
Current accounts	12		Rest of the world imports														Imports	Total imports
	13		Production activities														Domestic supplies of commodities	Total revenue
	14		Commodities	H'sehold consump. demand for goods, services				*Govt. demand for goods and services*				Investment expenditure			Exports	Raw material purchases		Total commodity demands
	15		Commodity taxes					Net commodity tax receipts									*Indirect tax rates, etc.*	
			Totals	Supply of want and need satisfactions	Incomes of domestic factors of production	Total outlay of households	Total outlay of companies	Total outlay of government	Revised wealth as domestic institutions			Revised factor endowments	Revised financial claims	Revised foreign claims	Total for. exch. receipts *less* imports	Total costs	Total commodity supplies	

column) is, in fact, a set of rows defined by the classification used with respect to that aspect of the economy, a very large table would be needed to show all the details. The SAM in Table 3 incorporates all the major transformations (such as that from the structure of production to the factorial income distribution, and from the latter to the household income distribution) and relationships contained in the modular framework. A change in any particular element, or account, occurring in this integrated and interconnected system must have repercussions elsewhere.

As in Table 1, the rows in Table 3 collect together receipts, while columns record the associated expenditures. Hence, each non-zero element of the table is a receipt when read in its row context, and an expenditure in its column. Row 1 of the table records wants in society. These are wants for food, clothing, housing, education, entertainment, leisure, etc. They are paid for by the expenditures of the different household groups in column 3. Thus at the intersection of row 1 and column 3 we have a table or submatrix showing how much is spent on each want (e.g. calories) by each type of household. The totals for the different wants in row 1 record the expenditures incurred in want satisfaction. For each household group these expenditures (or its consumption) are the numerator of its average living standard. The denominator is the poverty level, or the cost which would be incurred if all households in the group satisfied their minimum requirements but no more. Hence the matrix in row 1, column 3 records living standards and poverty within each socioeconomic group. Since we define the main policy objectives in terms of these variables, the purpose of the rest of the table is to ascertain how this particular submatrix is determined and may be altered.

It is quite evident from the above discussion that the quantification of the elements going into Table 3 is no trivial matter. However, it is worth noting that, subject to two main exceptions discussed below, the details it requires are already included within the United Nations System of National Accounts. Thus, subject to these exceptions, the details are within the system which countries have been recommended to adopt and which they have been making great efforts to introduce, and therefore the proposal to direct further efforts towards such a table is not in conflict with other recommendations and is not unrealistic. However, existing practice fails to capture the details which emerge from our study as being crucial. Evidence is difficult to produce, since to show the importance of classifications typically requires going back to primary data sources and reclassifying the results. While it is unfashionable to be concerned with economic statistics at this level, our analysis indicates that it is extremely important.

The two facets of economic activity introduced in Table 3 which are not part of the United Nations System of National Accounts are the accounts for wants, and the disaggregated household accounts. The households sector in aggregate is included, of course, while a disaggregated approach and much else that directly relates to our treatment of wants can be found in the United Nations' complementary System of Social and Demographic Statistics. But we do not want just a complementary system: the important point is to integrate questions of poverty and inequality into the aggregate economic framework--or even better to start off with them and to build the other details around them. One of our main recommendations is that work on national data systems can and should be reorganized so that planning can be concerned with poverty and inequality as well as growth.

An Application of a Basic Social Accounting Matrix to Sri Lanka

Table 4 applies the basic format of the SAM shown in Tables 1 and 2 to the specific case of Sri Lanka.

Reading across row 1 of the table, urban labor earns wages equal to 1,673 (in millions of rupees). These come from all production activities, but the most important are trade and private transport services (414) and government services (555). These are also important sources of earned income for rural labor (row 2). For them, however, rice cultivation (706) is also highly significant. The estate labor force (row 3) earns income primarily on the tea plantations (526). Thus the table captures the relationship between the structure of production and the sources of wages and jobs in different labor markets. It also shows how private profits (4,984 in total) tend to be concentrated in "other agriculture" (vegetables, spices, fruits) and in trade and private transport services. The surpluses of state-owned enterprises add up to 174 net, there being some industries, such as trade and construction transport, in which state enterprise makes a loss. In general the top righthand corner of Table 4 shows how much factor income is generated in the economy, the production activities it is generated by, and the factorial income distribution, i.e. the extent to which each factor of production receives a share of this income. This is the main part of national income accounting by sector of origin and of the distribution of income according to factor shares. Through the recognition of different parts of the labor market the dependence of each on different production activities can be recorded. The simplest example is that the estate labor force depends essentially on the tea industry and to a lesser extent on rubber for its employment.

The incomes of the six factors of production are laid out in the first six columns. Thus all urban labor income (1,673) goes to ur-

TABLE 4

A SOCIAL ACCOUNTING MATRIX FOR SRI LANKA, 1970 (in millions of rupees)

A social accounting matrix for Sri Lanka, 1970
(in millions of rupees)

Receipts					Expenditures 1						Expenditures 2			Expenditures 3		Expenditures 4	Expenditures 5	Expenditures 6											Expenditures 7	
					Factors of production						Institutions			Institutions				Production activities												
					Labour			Other			Current accounts			Current accounts																
											Households																		
					Urban	Rural	Estate	Housing	Other private	Public	Urban	Rural	Estate	Private corporations	State corporations	Government	Combined capital assets	Tea	Rubber	Coconuts	Rice	Other agriculture	Food and drink	Other industry	Trade and construction transport	Trade and private transport services	Private services	Government services	Rest of the world	Totals
1	Factors of production	Labour	Urban															5	5	9	25	75	46	182	81	414	276	555		1673
			Rural															43	158	67	706	247	68	259	159	487	276	715		3185
			Estate															526	133	11		5	4	2	5	8	12	5		711
		Other	Housing															13	24	442	282	1259	184	604	742	1424	633		–113	633
			Other private																			11	12	109	–8	–1	123			4984
			Public																								73			174
2	Institutions	Current accounts	Households	Urban	1673			137	662					434		91													6	3003
				Rural		3185		330	3026					203		151													6	6901
				Estate			711	31	30					7		6													6	791
3			Private corporations					135	1266							57													–15	1443
4			State corporations							174						237														411
5			Government								368	194	4	272	104		313	33	4	14	10	19	288	216	66	130	76	29	94	2234
			Combined capital account								519	807	11	527	307	43													425	2639
6	Production activities		Tea								14	55	7				–55										2	2	839	864
			Rubber														25							8					341	374
			Coconuts								54	208	27				29							8			6	4	2	577
			Rice								158	760	102				105				1082			2			15	18		2242
			Other agriculture								357	980	139					11	1		2	95	63	34	3		39	16	106	1846
			Food and drink								253	641	82				37				9	11	24	188			29	8	84	1276
			Other industry								258	621	69				72	97	24	9	35	69	49	554	417	172	37	66	241	2790
			Construction														1596							1		7	50	92		1748
			Trade and transport								410	1074	122				154	60	10	8	44	23	95	249	206	96	42	59	203	2845
			Private services								405	920	85					11	3	7	15	1		4	9	38	55	37	287	1877
			Government services													1649														1649
7		Rest of the world									207	741	143				364	75	12	10	32	53	204	370	65	70	133	43		2522
Totals					1673	3185	711	633	4984	174	3003	6901	791	1443	411	2234	2639	864	374	577	2242	1846	1276	2790	1745	2845	1877	1649	2522	

ban households. For rental income and private profits the allocation is more difficult: it depends on who owns the corresponding factors, since rents go to the owners of housing while profits go to the owners of capital, i.e. to companies or to the household owners of unincorporated businesses.

The current accounts for institutions show three sorts of household, two types of companies, and government. The column 7 sums for the institutions show their total incomes. These come primarily from supplying factor services, but there are also incomes received from other institutions (i.e. transfer payments). These are primarily profit distributed by companies, benefits paid by government, and tax payments to government.

Conclusions and Policy Inferences

The three most important contributions which the present approach appears to make to the planning process are: (a) the specification of a system for classifying and collecting empirical information in a way appropriate to the planning of the economic and social development process; (b) the construction of the modular conceptual framework which brings out explicitly, in a consistent way, the interdependence between the various parts and variables of the complete system; and (c) the incorporation of policy means and policy objectives in the framework. Potentially, this last contribution permits the identification of appropriate development strategies and, more generally, the simulation of the likely effects of alternative policy packages on the policy objectives within a dynamic setting. All three contributions are highly inter-related.

As Table 3 illustrates, the planning framework embraces a number of modules (or subsystems), each with its own set of relationships between variables and corresponding accounts. In turn, the various subsystems are connected by relationships which act as links between one set of variables and another. The SAM provides the appropriate classification, the organization schema and the underlying algebra for this analytical framework. The values of all endogenous variables can be generated as functions of a set of exogenous variables (shown in italics in the table) representing the initial condition and the policy measures under the control of government.

It is because the initial conditions prevailing among developing countries can differ significantly in terms of such factors as the initial resource endowment and pattern of ownership, the stage of development, the institutional setting, and the availability of information that a flexible approach to planning is required. It has already been seen that an important advantage of the modular approach is that it provides much scope for flexibility in the specification of the planning framework.

Given this diversity of settings faced by developing countries and the multiplicity of objectives, such as growth and poverty alleviation, which the planner has to focus upon, a modular consistency approach is likely to be the most useful operationally. One major advantage of the consistency framework is that it allows the effects of alternative policy packages on the policy objectives to be traced out in the form of what might be called a "policy navigation table."

Since we are interested in improving the standard of living of individuals and reducing poverty, it is essential to link our performance index (i.e. the geometric mean income) to the basic needs and wants of households, particularly the poor ones. Given a certain society and environment, it is possible to specify minimal requirements for a whole bundle of goods and services, and to trace over time the consequences of alternative policies on the growth rate of living standards of different household groups. This process might reveal, among other things, the undesirable effects of too great an emphasis given to equity today on the growth and equity of tomorrow--particularly if the policy were based mainly on consumption transfers.

Consequently it would be quite meaningless from a planning standpoint to limit oneself to a static framework and a performance measure which focused only on the distribution among individuals of a fixed basket of goods. The fact that growth is not seen as a sole objective of development in no sense implies that it is irrelevant. On the contrary, growth is essential if poverty is to be relieved, especially in many parts of South Asia where the current level of production is simply not sufficient to provide a decent standard of living for everyone even if total income were to be equally distributed. A trade-off can exist between growth and equality over time.

A major contribution of this planning framework is that the variables in the respective subsystems are broken down in an operationally useful way, while the SAM provides a comprehensive survey of the complete classification scheme and of the transformation, or mapping, between classifications used in the different modules. Thus it can be recalled, following the interdependent sequence represented in Figure 2, that households are divided into relatively homogeneous groups according to criteria such as socio-economic factors, regional considerations and similarities in terms of wealth, income and consumption patterns. Wants are broken down into meaningful categories to reflect food, clothing, shelter and other requirements. Commodities, in turn, are divided into classes permitting an easy mapping of them as means for satisfying the needs and wants expressed by the household groups.

Next in our sequence, production activities are defined along criteria such as types of commodities produced, form of organization (i.e. formal, informal) and technology used. In addition, a distinction is made between, first, goods and services which are produced for the market, and second, those which are not and hence lead to imputed (as opposed to actual) income. The production of goods and services requires both intermediate and primary factors of production. The derived demand for the latter generates value added which represents the major source of income accruing to the factors of production. These factors are broken down according to occupational and skill characteristics with regard to labor, according to age and other technological factors for capital inputs, and finally, according to agronomic and regional criteria with respect to land. Hence, the value added returns accruing to these inputs from the production activities generate a factorial income distribution which, finally, can be mapped into the corresponding distribution of income over household groups and other institutions (government and companies). The circular framework in Figure 2 is then completed by providing the various categories of households and other institutions with the incomes which determine, in turn, the expenditures pattern of the latter.

Some observations are in order with regard to the operational usefulness of this framework and the corresponding data system for formulating development strategies. First, it should be clear by now that it provides a systematic and consistent way of identifying the initial conditions which exist in an economy. Obviously, an appropriate and thorough specification of the initial conditions yields a policy diagnosis and foundations upon which a development strategy can be built. Different initial conditions will require different packages of policy measures, even where the objective function is similar. The social accounting matrix thus suggests the kind of data needed for policy formulation, and the form in which this information might be presented. Hence the complete classification scheme that underlies the various subsystems of the SAM provides gudelines to statistical offices regarding the specific types of information that policy makers should seek. Such guidelines may be of great assistance to statistical offices in the process of designing surveys and censuses, and in gathering and tabulating other types of information.

A second major advantage of our framework is that it allows a certain amount of policy simulation. The effects of alternative policy packages on the whole system over time can, as noted earlier, be traced out to form policy navigation tables. This can be done with or without a specified policy objective. When one or more objectives are specified, they can then be applied to the "navigation tables" to find what might be termed a "policy feasibility

space" within which an appropriate strategy can be chosen. This approach to planning is thus quite flexible.

Furthermore, the framework seems applicable to countries following very different economic and political systems, from an essentially mixed economy to a controlled economy. The only qualification is that government should have an interest in exploring the fulfillment of basic needs over time. The framework can to a limited extent estimate the trade-off between an improvement in the current standard of living of the different household groups and future improvements. In a more general sense, the policy navigation tables illustrate quantitatively the growth paths in the living standards of the various household groups. By revealing to the policy maker the extent to which basic needs can be fulfilled over time, the ultimate choice will depend, of course, on his distributional time preference.

Editorial Note. This extract is intended to give readers a very general idea of what a social accounting matrix is, what it looks like in a static form, and what it could do if completed with appropriate data. We cannot briefly explore the dynamics, and all the functional relationships within as well as among modules. Thus we cannot illustrate how it could be used to form a "policy navigation table," and to locate effective policies combining growth and anti-poverty objectives.

U.S. GOVERNMENT PRINTING OFFICE: 1980—310-928/1

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